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**AERONAUTICS**

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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*VOLUME 16 NUMBER 22 / NOVEMBER 23, 1978*

# TABLE OF CONTENTS

## AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

**01 AERONAUTICS (GENERAL)** 2889

**02 AERODYNAMICS** 2889

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*.

**03 AIR TRANSPORTATION AND SAFETY** 2892

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

**04 AIRCRAFT COMMUNICATIONS AND NAVIGATION** 2893

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command and Tracking* and *32 Communications*.

**05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE** 2895

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

**06 AIRCRAFT INSTRUMENTATION** 2897

Includes cockpit and cabin display devices, and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

**07 AIRCRAFT PROPULSION AND POWER** 2897

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

**08 AIRCRAFT STABILITY AND CONTROL** 2900

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

**09 RESEARCH AND SUPPORT FACILITIES (AIR)** 2901

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

## ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*.

**12 ASTRONAUTICS (GENERAL)** 2902

For extraterrestrial exploration see *91 Lunar and Planetary Exploration*.

**13 ASTRODYNAMICS** 2903

Includes powered and free-flight trajectories; and orbit and launching dynamics.

**14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)** N.A.

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air)*.

**15 LAUNCH VEHICLES AND SPACE VEHICLES** 2903

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

**16 SPACE TRANSPORTATION** N.A.

Includes passenger and cargo space transportation, e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

**17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING** 2905

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

**18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE** 2906

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

**19 SPACECRAFT INSTRUMENTATION** **N.A.**

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

**20 SPACECRAFT PROPULSION AND POWER** **2906**

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

## CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

**23 CHEMISTRY AND MATERIALS (GENERAL)** **2907**

Includes biochemistry and organic chemistry.

**24 COMPOSITE MATERIALS** **2908**

Includes laminates.

**25 INORGANIC AND PHYSICAL CHEMISTRY** **2909**

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

**26 METALLIC MATERIALS** **2913**

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

**27 NONMETALLIC MATERIALS** **2917**

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

**28 PROPELLANTS AND FUELS** **2920**

Includes rocket propellants, igniters, and oxidizers; storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion*.

## ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

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**31 ENGINEERING (GENERAL)** **2922**

Includes vacuum technology; control engineering; display engineering; and cryogenics.

**32 COMMUNICATIONS** **2929**

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking*.

**33 ELECTRONICS AND ELECTRICAL ENGINEERING** **2935**

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

**34 FLUID MECHANICS AND HEAT TRANSFER** **2939**

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

**35 INSTRUMENTATION AND PHOTOGRAPHY** **2942**

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation*.

**36 LASERS AND MASERS** **2944**

Includes parametric amplifiers.

**37 MECHANICAL ENGINEERING** **2946**

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

**38 QUALITY ASSURANCE AND RELIABILITY** **2948**

Includes product sampling procedures and techniques; and quality control.

**39 STRUCTURAL MECHANICS** **2949**

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

## GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

For related information see also *Space Sciences*.

**42 GEOSCIENCES (GENERAL)** **N.A.**

**43 EARTH RESOURCES** 2953
Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography*.

**44 ENERGY PRODUCTION AND CONVERSION** 2958
Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.
For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels*, and *85 Urban Technology and Transportation*.

**45 ENVIRONMENT POLLUTION** 2966
Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

**46 GEOPHYSICS** 2971
Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.
For space radiation see *93 Space Radiation*.

**47 METEOROLOGY AND CLIMATOLOGY** 2976
Includes weather forecasting and modification.

**48 OCEANOGRAPHY** 2978
Includes biological, dynamic and physical oceanography; and marine resources.

## LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and planetary biology.

**51 LIFE SCIENCES (GENERAL)** 2979
Includes genetics.

**52 AEROSPACE MEDICINE** 2982
Includes physiological factors; biological effects of radiation; and weightlessness.

**53 BEHAVIORAL SCIENCES** 2986
Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT** 2986
Includes human engineering; biotechnology; and space suits and protective clothing.

**55 PLANETARY BIOLOGY** N.A.
Includes exobiology; and extraterrestrial life.

## MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

**59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)** N.A.

**60 COMPUTER OPERATIONS AND HARDWARE** 2989
Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering*.

**61 COMPUTER PROGRAMMING AND SOFTWARE** 2992
Includes computer programs, routines, and algorithms.

**62 COMPUTER SYSTEMS** 2997
Includes computer networks.

**63 CYBERNETICS** 2998
Includes feedback and control theory.
For related information see also *54 Man/System Technology and Life Support*.

**64 NUMERICAL ANALYSIS** 2999
Includes iteration, difference equations, and numerical approximation.

**65 STATISTICS AND PROBABILITY** 3001
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

**66 SYSTEMS ANALYSIS** N.A.
Includes mathematical modeling; network analysis; and operations research.

**67 THEORETICAL MATHEMATICS** 3003
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Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.
For related information see also *Engineering*.

**70 PHYSICS (GENERAL)** 3003
For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar Physics*.

**71 ACOUSTICS** 3004
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

**72 ATOMIC AND MOLECULAR PHYSICS** 3006
Includes atomic structure and molecular spectra.

**73 NUCLEAR AND HIGH-ENERGY PHYSICS** 3006
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

**74 OPTICS** 3007
Includes light phenomena.

**75 PLASMA PHYSICS** 3009
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

**76 SOLID-STATE PHYSICS** 3010
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

**77 THERMODYNAMICS AND STATISTICAL PHYSICS** 3014
Includes quantum mechanics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

## SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

**80 SOCIAL SCIENCES (GENERAL)** 3014
Includes educational matters.

**81 ADMINISTRATION AND MANAGEMENT** 3015
Includes management planning and research.

**82 DOCUMENTATION AND INFORMATION SCIENCE** 3015
Includes information storage and retrieval technology; micrography; and library science.
For computer documentation see *61 Computer Programming and Software.*

**83 ECONOMICS AND COST ANALYSIS** 3016
Includes cost effectiveness studies.

**84 LAW AND POLITICAL SCIENCE** 3016
Includes space law; international law; international cooperation; and patent policy.

**85 URBAN TECHNOLOGY AND TRANSPORTATION** 3017
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

## SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

**88 SPACE SCIENCES (GENERAL)** 3018

**89 ASTRONOMY** 3025
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

**90 ASTROPHYSICS** 3026
Includes cosmology; and interstellar and interplanetary gases and dust.

**91 LUNAR AND PLANETARY EXPLORATION** 3026
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

**92 SOLAR PHYSICS** 3027
Includes solar activity, solar flares, solar radiation and sunspots.

**93 SPACE RADIATION** 3027
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

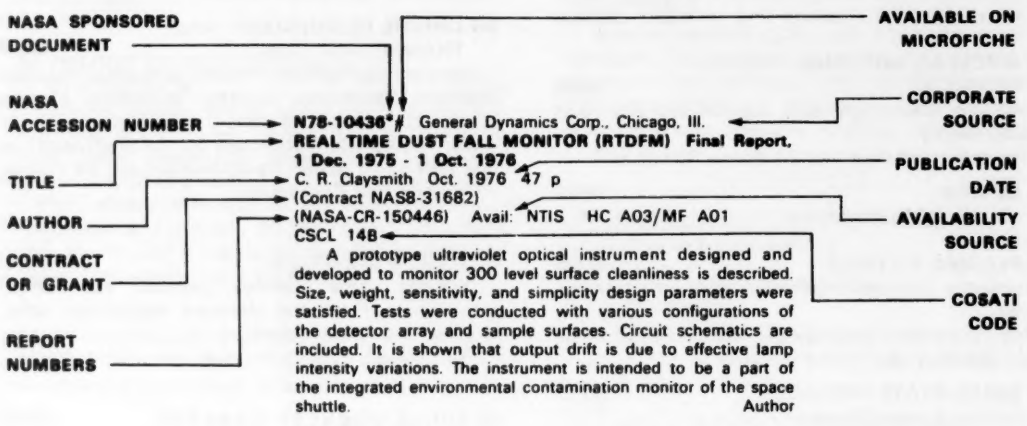
## GENERAL

**99 GENERAL** 3029

Note: N.A. means that no abstracts were assigned to this category for this issue.

**SUBJECT INDEX** ..... I-1
**PERSONAL AUTHOR INDEX** ..... I-51
**CORPORATE SOURCE INDEX** ..... I-59
**CONTRACT NUMBER INDEX** ..... I-73
**REPORT/ACCESSION NUMBER INDEX** ..... I-77

# TYPICAL CITATION AND ABSTRACT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N78-10436*# General Dynamics Corp., Chicago, Ill.
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REAL TIME DUST FALL MONITOR (RTDFM) Final Report, 1 Dec. 1975 - 1 Oct. 1976
TITLE
C. R. Claysmith Oct. 1976 47 p
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(Contract NAS8-31682)
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COSATI CODE
A prototype ultraviolet optical instrument designed and developed to monitor 300 level surface cleanliness is described. Size, weight, sensitivity, and simplicity design parameters were satisfied. Tests were conducted with various configurations of the detector array and sample surfaces. Circuit schematics are included. It is shown that output drift is due to effective lamp intensity variations. The instrument is intended to be a part of the integrated environmental contamination monitor of the space shuttle.
Author
REPORT NUMBERS

# ON-GOING RESEARCH PROJECTS

*This is a listing of research projects— not publications*

## AERONAUTICS

**Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.**

**1.0001, DYNAMIC RESPONSE OF TAILORED COMPOSITE STRUCTURES**
*I.F. HOLEHOUSE*, Rohr Marine Incorporated, *Chula Vista, California* 92012 (DF139810; F33615-77-C-3033)

Past composite panel designs for application in a high-intensity noise environment have followed closely the designs used for metal structures. Some of the advantages of composite materials such as tailorability have not been fully exploited to provide optimum structural design. The objective of this program is to develop the techniques for designing advanced composite panels and substructures for minimum dynamic stress response and maximum fatigue life when exposed to high-intensity noise loading.

The approach is to conduct analytical and experimental investigations using the tailorability of advanced composite construction to minimize the stress response and maximize fatigue life under acoustic excitation by optimizing the number of plys, orientation of plies, the type of matrix material, joint design, stiffener design and configuration.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

**1.0002, MICROMECHANICS AT BLUNTING CRACK TIPS**
*D.M. PARKS*, Yale University, School of Engineering, *New Haven, Connecticut* 06520 (DF140990; AF-AFOSR-3424-77)

Structural safety of current and future USAF tactical and strategic aircraft is a continuing problem. To insure that safety and durability are achieved for individual aircraft, methods must be developed to characterize subcritical ductile crack growth in the presence of large-scale plasticity. The objective of this effort is to develop methodology to account for this effect in crack growth analyses. These methods will lead to improved life prediction techniques providing increased safety and more cost-effective operation of USAF aircraft.

The validity of one parameter characterizations rests on the size scale, near the crack tip, over which the one parameter field dominates. Rigorous finite strain, finite-element studies of the effects of yield, hardening, and remote flow fields on the blunting of a crack tip will be performed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

**1.0003, ANALYSIS OF HELICOPTER MAINTENANCE FAULT ISOLATION CRITERIA/TECHNIQUES**
*UNKNOWN*, United Technologies Corp., *Stratford, Connecticut* 06602 (DA0E3794; DAAJ02-77-C-0071)

The objective of this effort is to establish a clear relationship between failure symptoms to failed component and to develop an effective criteria/technique to indicate same.

To meet the above objective, the following will be accomplished: (1) identify major troubleshooting problem areas according to operational impact (safety, mission reliability, availability, etc.); (2) quantify the identified problem areas in terms of maintenance effort and cost; (3) analyze the identified problem area to establish symptom to failed component relationships and to determine the deficiencies in existing criteria/technique; (4) develop a maintenance procedure and equipment (diagnostic) criteria/technique which can clearly identify symptom or problems; and (5) develop a program for verification of improved criteria/technique for the correction of noted problems.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Research & Technology Lab.

**1.0004, INTEGRATED THERMAL AVIONICS DESIGN**
*R.F. PORTER*, Westinghouse Electric Corp., *Baltimore, Maryland* 21203 (DF140690; F33615-77-C-2074)

Avionics equipment account for a substantial share of weapon system ownership cost which is strongly driven by equipment reliability in the severe airborne environment. Ownership cost can be controlled by moderating environments and designing environmentally resistant equipment. Tools for designing avionics equipment in a life-cycle cost context are needed to reach the minimum weapon system life-cycle cost goal advocated by DOD directives. The objective of this effort is to make a quantum reduction in weapon system ownership cost by increasing the environmental resistance and protection and thus the reliability of avionic equipment.

Total program and costs will be defined in order to create a computer-aided design and analysis (CAD) capability in the area of thermal design of avionics hardware. Constituent analysis tools will be identified that will provide visibility into the mutual influence of avionics system and the total weapon system with regard to physical characteristics, operational penalties, reliability, and life-cycle cost. Design modules will be identified to develop compatible designs that permit an approach to a minimum life-cycle cost design for the weapon system. The effort will include optimal thermal design and comparative cost analysis of multilayer circuit boards.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

**1.0005, OMNIDIRECTIONAL LOW AIRSPEED INDICATOR**
*F. HOERNER*, U.S. Navy, Air Test Center, *Patuxent River, Maryland* 20670 (DN793253)

Provide more sensitive low speed indicator for helicopters.

Procure improved airspeed indicator plan and conduct flight tests.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**1.0006, DEVELOPMENT OF IMPROVED MASS RATE OF FUEL FLOW TRANSMITTER FOR FUTURE NAVY AIRCRAFT**
*L. LYNNWORTH*, Parametrics Incoroporated, *Waltham, Massachusetts* 02154 (DN881388; N62269-77-C-0363)

The general objective of this task is to further develop Navy capability to define and specify jet engine fuel system components

for advanced types of Navy aircraft in the 1980 era. Future naval aircraft, and in particular the V/STOL, will require both airframe and engine sensors that are improvements over the current state of the art. This comes about as a result of the V/STOL flight regime which is very demanding, especially in the area of fuel management. With fuel management judged to be increasingly critical, and engine diagnostics a distinct possibility for V/STOL, the need exists for a fuel flow transmitter having a high degree of accuracy and day-to-day repeatability. This contract supports work unit ZA601, Agency Accession No. DN681080.

Manufacturers of this type of equipment were contacted via RFP containing a work statement embodying those requirements necessary to meet the objective.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**1.0007, TACTICAL MISSILE PROPULSION INTEGRATION STUDY**

*J. KINROTH*, McDonnell Douglas Astro. Co., *St. Louis, Missouri* 63166 (DF461360; F33615-77-C-2076)

Develop ramjet engine configurations in support of AF missions and studies. Generate mission effectiveness charts using ramjet propulsion concepts. Develop handbook instructing mission analysis engineers on the methods of ramjet design. Handbook will include ramjet S-O-A tables and plots.

Utilize ramjet S-O-A and available design methods to support AF missile configuration development. Handbook shall describe design techniques.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

**1.0008, LAUNCH, RECOVERY AND GUIDANCE TECHNIQUES FOR FUTURE CARRIERS**

*T. GIOA*, U.S. Navy, Engineering Department, *Lakehurst, New Jersey* 08733 (DN696002)

To keep pace with post-1975 military developments, the Navy is conducting investigations into the development of high-speed aircraft carriers. A parallel study to investigate problem areas and recommend development of launching, recovery, and vla systems compatible with high wind environment is required to make high-speed carriers operationally successful.

Conduct studies to establish the environmental parameters and related problems that must be resolved for launching, recovery and VLA systems operations aboard high-speed carriers. For launcher systems, the following must be investigated: configuration of high-speed carriers and related launcher system requirements; projected aircraft that will be used; crew and aircraft protection and flight operation evolutions in high wind environment; topside and below-deck launcher system configuration and weight, space, and power requirements, auxiliary support systems required. For recovery systems establish high-speed carrier aircraft recovery requirements; crew and aircraft protection devices; automatic positioning guidance and tie-down of aircraft after recovery; transition effects on the aircraft from high wind environment to protected hangar area recovery area arrangement, space, weight, and deck configuration requirements. For VLA systems, assess VLA system requirements, environmental parameters and conduct deck configuration studies.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

**1.0009, RADIATION AUGMENTED COMBUSTION**

*A.E. CERKANOWITZ*, Exxon Res. & Engineering Co., *Linden, New Jersey* 07036 (DF048730; F49620-77-C-0085)

AF function - advanced air-breathing engines, airborne reconnaissance and transport, weapon delivery and defense. Deficiency -present aircraft operation limited by combustion associated phenomena such as flammability, flame propagation, ignition and stable combustion. insufficient understanding available of basic mechanisms and processes associated with promising techniques for enhancement of combustion and combustion initiation and for evaluation of feasibility of concept for extending operability range and stability. Objective - to investigate and evaluate the feasibility of various techniques in extended current aircraft operational limitations due to combustion associated phenomena with emphasis on photochemical techniques. To formulate realistic mathematical models describing the ignition, combustion and stability enhancement phenomena. How work contributes - will provide additional understanding and modeling of processes associated with ignition, combustion and stability enhancement, will aid in evaluating the potentials of various techniques, including photochemical energy addition, for providing efficient means of extending aircraft operational range beyond the continuous flight corridor presently dictated by normal (spark) ignition.

This program encompasses investigation and feasibility of promising techniques for extending aircraft operational limitations due to combustion associated phenomena. Emphasis will be on study of photochemical radiative augmentation techniques to enhance combustion, initiation, reaction kinetics and propagation rate. Particular attention will be given to combustion aspects which represent limiting conditions on combustor operation such as flammability limits, flame propagation, ignition and stability limits. Other approaches such as use of laser irradiation, modified spark and plasma-torch will also be considered. suitable vacuum ultraviolet and ultraviolet sources will be acquired and fully characterized using spectroscopic and combustion diagnostic techniques. Additional tests will delineate photon-reactant mixture interaction. Characterization of enhanced ignition and combustion by photochemical and other techniques at aircraft combustor and afterburner conditions will be explored in a flow combustor both in a simple premixed mode and in a cannular combustion mode using gaseous and liquid fuels. Consistent experimental and theoretical descriptions of the ignition and combustion enhancement phenomena will be developed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

**1.0010, VTOL AERODYNAMICS**

*R. MELNIK*, Grumman Corporation, *Bethpage, New York* 11714 (DN775687; N00014-77-C-0524)

The overall mission capability of a high-performance VTOL aircraft depends critically upon optimization of the aircraft characteristics at lift-off. The objective of the proposed theoretical study is to provide a quantitative understanding of the fluid dynamics of a VTOL aircraft in proximity of the ground.

The overall flow field associated with a VTOL aircraft in the vicinity of the ground will be segmented into a sub-system of coupled, but more simply described regions based on a formal asymptotic analysis. the regions will be characterized as inviscid, boundary layer-like, and strong interaction. The equations appropriate, for each individual region will be derived and studied in detail. The subdivision of the flow will follow from the asymptotic analysis as a consequence of the assumptions that, the reciprocal of the Reynolds number, the spreading rate of the VTOL jet, and the ratio of the jet diameter to the distance of the VTOL above the ground all approach zero.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**1.0011, STUDY OF POTENT SEA-BASED NAVAL RESERVE CONCEPT**

*E.H. HEINEMANN*, Technical Audit Assn. Inc., *New York, New York* 10017 (DN890064; N00019-78-C-0232)

Study the feasibility of designing and producing a low-cost weapons system consisting of a highly maintainable multipurpose fighter attack aircraft and delivery ship for use by naval reserve forces.

A review panel of highly qualified experts in the fields of aircraft and ship design/interface and naval operations will review the concept and prepare a comprehensive report on the feasibility of the proposed weapons system.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

**1.0012, FEASIBILITY OF MONITORING THE ACCUMULATION OF FATIGUE DAMAGE ON CRITICAL STRUCTURAL COMPONENTS OF OPERATIONAL FLEET HELICOPTERS**

*G.E. BRAZIER*, Technology Incorporated, *Dayton, Ohio* 45431 (DN790048; N00019-77-C-0318)

The acceptable system defined in this proposed study will satisfy the three objectives related to fatigue components during the service lifetime of a helicopter fleet; that is, the continuing assessment of service reliability, the rational adjustment of inspection and maintenace requirements, and the improvement of design criteria for future helicopters.

The contractor will investigate the requirements of the Navy RH-53D program for a structural integrity recording system (SIRS), define the flight condition monitoring concept for the RH-53D application, define SIRS for the RH-53D application, determine its cost-effectiveness, and a pilot program to demonstrate it on a selected sample of helicopters performing normal missions.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

**1.0013, TF34 ENGINE TEST**

*M. COLE*, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF462080)

To provide definition and assessment of performance, functional, and life characteristics of the TF34 model engine.

Conduct a series of sea-level static tests in the AFAPL facilities to acquire and analyze performance, functional and life data of the TF34 engine and submit appropriate recommendations regarding current problem solutions and improvements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

**1.0014, CERTIFICATION OF COMPOSITE AIRCRAFT STRUCTURES UNDER IMPACT, ENVIRONMENTAL AND FATIGUE CONDITIONS**

*P.C. CHOU*, Drexel University, School of Engineering, *Philadelphia, Pennsylvania* 19104 (DN781456; N62269-76-C-0378)

To obtain some of the properties that will be needed for establishing certification standards for using advanced composites in aircraft structures. The three critical loading conditions to be studied are impact, environmental and scale effects in fatigue. This contract supports work unit DG602, agency accession no DN 133126.

General design curves will be developed to predict the low-velocity impact response of orthotropic plates both simply supported and with built-in edges. Experiments on instrumented plates will be carried out to verify the impact response. Compression tests will be carried out on laminates following thermal and humidity conditioning. A model will be developed to predict the compressive strength taking into account residual thermal stress and the influence of moisture on matrix properties. A statistical theory to predict the fatigue behavior of complete structures based on characterization of sub-element properties will be devised and verified on a simplified structure.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**1.0015, VARIABLE CAMBER ADVANCED WING AERODYNAMIC DESIGN PROGRAM**

*L. ROBINSON*, Vought Corporation, *Dallas, Texas* 75222 (DN881147; N62269-76-0361)

To expand the aerodynamic data base for a skewed hingeline, multiple-panel leading edge/trailing edge variable camber wing. This contract supports work unit ZA601, 'Aircraft Technology,' Agency Accession Number DN781080.

Existing tunnel data will be analyzed/transformed to predict aircraft-installed aerodynamic characteristics of the VSD advanced variable camber wing. Comparisons of three camber configurations will be made, i.e., zero camber, fixed l.e., conical camber, and VSD variable camber. Transonic performance will be predicted for all three configurations to determine the merits of the VSD variable camber concept.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**1.0016, HELICOPTER OBSTACLE STRIKE TOLERANCE**

*B.P. GUPTA*, Bell Helicopter Company, *Fort Worth, Texas* 76101 (DA0E3780; DAAJ02-77-C-0049)

To develop design concepts and criteria which will reduce the frequency and severity of Army helicopter accidents attributable to obstacle strikes. This effort is directed at both current operational and future Army helicopters.

Define the problem in terms of strike causing obstacles and operations, resulting failure modes and mishap class-strike-cost-injury relationships. Formulate and analyze strike tolerance concepts for fuselage, landing gear, and rotors. Select the most promising concepts considering effectiveness, cost, aircraft performance, and retrofit suitability. Derive helicopter obstacle strike tolerance design criteria for system as a whole.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Research & Technology Lab.

**1.0017, ASSEMBLY COST FOR COMPOSITE STRUCTURES**

*L. MCKENZIE*, General Dynamics Corporation, *Fort Worth, Texas* 76101 (DF140250; F33615-77-C-3076)

The Air Force, in order to maintain air superiority, must obtain advanced aerospace vehicles and modify existing systems. Reliable cost and weight analysis is required if these systems are to have the minimum cost for the acceptable level of performance. The objective of this effort is to develop a preliminary design level technique for the cost estimation of advanced composite flight vehicle structures. This will provide a high level of confidence in the cost of composite construction.

This study will integrate and expand on previously developed methodology provided by the Air Force Contract F33615-75-C-3103 and will support the development of the structural technology evaluation program. The model will use the industrial engineering standards approach which will generate the desired confidence and provide a high-quality cost estimate.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

**1.0018, R&D PROGRAM DOCUMENTATION FOR AERO STRUCTURES DIVISION**

*UNKNOWN*, Telcom Incorporated, *McLean, Virginia* 22101 (DN881377; N62269-77-M-4170)

To provide program documentation for the structures R&D program being administered by the Aero Structures Division. This work is in support of work unit ZA601, 'Aircraft Technology' Agency Accession No. DN 681080.

Technical services are being provided to prepare the exploratory development plan, road map, and supporting graphics and documentation from technical inputs by the program managers.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**1.0019, HT RM 78-28 - ANALYSIS OF HIGH-FREQUENCY VIBRATION DATA**

*R. HUNTHAUSEN*, U.S. Army, Applied Technology Laboratory, *Newport News, Virginia* 23604 (DA0E3815)

To investigate the feasibility of using high-frequency vibration data to diagnose the condition of helicopter drive train components.

Using vibration data acquired on known discrepant parts during the AIDAPS program, apply latest and most advanced techniques of analysis and attempt to establish correlation between the analysis results and the known part condition.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Research & Technology Lab.

**1.0020, HT PP 78-31 - MINI-RPV PROPULSION SYSTEM TESTS AND EVALUATION**
*UNKNOWN*, U.S. Army, Applied Technology Laboratory, *Newport News, Virginia* 23604 (DA0E3831)

This house task has two major objectives for FY78: (1) government evaluation of the two 20 HP mini-RPV demonstrator engines to determine their limitations and capabilities through component/system Tests, and (2) to define an integrated propulsion system for future RPV aircraft.

Conduct performance (dynamometer) and endurance (propeller) testing of the two 20 hp mini-RPV demonstrator engines currently under contract. Test individual components/systems (engine/alternators, propeller, fuels, oils) to define their limitations and test complete propulsion packages. Obtain potential propulsion system components/systems and run tests to evaluate performance and durability to assist in defining an integrated propulsion package. Define cooling requirements and configurations for a total integrated RPV propulsion package through experimental integration of previously developed components.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Research & Technology Lab.

**1.0021, REDUNDANT, INTEGRATED INERTIAL SENSOR ASSEMBLIES FOR ADVANCED NAVY/MARINE CORPS AIRCRAFT**
*J.F. GILBERT*, Boeing Company, *Seattle, Washington* 98108 (DN890038; N00019-77-C-0506)

The objective of this program is to conduct research and development studies and analyses which will serve as the basis for the development of new integrated avionics concepts for application in advanced Navy/Marine Corps aircraft. Specifically, this program involves the definition, study and analysis of redundant, integrated inertial sensor assemblies employing strapdown laser gyros, and study and analysis of integrated inertial/air data computations. The resultant integrated systems will provide significant improvements in operational capability and substantial reductions in maintenance, logistics support, and life-cycle-costs.

The approach taken shall be to: define the aircraft, environment, composite missions, performance goals, output requirements and reliability requirements; define candidate system configurations for analysis; perform theoretical computational analyses; postulate redundancy management techniques for each configuration; study hardware modularity and specify LRU partitioning; estimate system performance and life-cycle-costs; identify high-risk areas; and document results.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

## CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

**3.0001, APPLICATION OF PATCHES-III TO PROBLEMS IN COMPOSITE STRUCTURES**
*E.L. STANTON*, Prototype Dev. Assoc. Inc., *Santa Ana, California* 92705 (DN881115; N62269-77-C-0144)

To evaluate the effects of disbonds, cracks, and other anomalies on the three-dimensional stress fields in composite laminates. To improve the accuracy and computational efficiency of the tricubic isoparametric finite-element computer program, PATCHES-III. This contract is in support of work unit DG 602, 'Airframe Structural Mechanics', Agency Accession No. DN 133126.

The solution method used in PATCHES-III will be revised to reduce core requirements, increase computation speed, and reduce the number of iterations required for convergence. Additional user options will be added to selectively downgrade the elements from tricubic to trilinear, or any combination between such that the higher-order elements are used only where necessary, and the total degrees of freedom of the model are reduced. Models of a disbonded laminate in compression, and of an intact laminate subject to bearing loads will be prepared and analyzed using the improved program.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**3.0002, DYNAMICS OF MULTIPHOTON ULTRAVIOLET PHOTODISSOCIATION**
*W.M. JACKSON*, Howard University, School of Liberal Arts, *Washington, District of Columbia* 20001 (CHE78-05375)

Dr. Jackson intends to continue and expand a program of research in the area of photochemistry. He will study the sequential multiphoton absorption by molecules of ultraviolet radiation produced by an argon fluoride laser. The absorption yields highly excited molecules which dissociate and yield small radicals which are electronically excited. Emission resulting from the decay of the radicals will be identified and measured. The effects of experimental parameters such as pressure, laser intensity, laser wavelength, and time will be investigated. Ground state products will be determined by laser induced fluorescence and with a quadrupole mass spectrometer. Such studies provide information about the properties of excited molecular fragments. Such information has potental importance with regard to future practical applications of lasers to chemistry.

This grant renews support of a research program currently supported under NSF Grant CHE-7512848.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

**3.0003, HIGH-DENSITY FUEL COMBUSTION**
*M.T. MCCALL*, Martin Marietta Corporation, *Baltimore, Maryland* 21227 (DN590212; N00019-76-C-0683)

Research and development programs are in progress for the synthesis and characterization of high-density hydrocarbons for use as air-breathing missile fuels. Part of this characterization includes a determination of the combustion efficiencies and other combustion parameters for these new potential fuels.

A simplified system for simulating missile engine systems will be devised by coupling an ultrasonic nebulizer to a shock tube to generate fuel droplets and study the combustion.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

**3.0004, THEORETICAL STUDIES OF POSITRON/MOLECULE SYSTEMS AND THEIR ANNIHILATION**
*P.E. CADE*, Univ. of Massachusetts, Graduate School, *Amherst, Massachusetts* 01002 (CHE77-08542 A01)

Dr. Cade will study the electronic structure of positron/molecule systems, which are chemical entities with very short lifetimes (about 10 to the minus 9th power sec) and hitherto unstudied properties. The major thrust of this research is to establish the existence (or not) of these unusual new species. The methods of quantum chemistry with extension to special requirements for positrons will be employed in these theoretical studies. Several investigations are planned: (1) Benchmark studies of small molecules such as (H anion; e ion) and (Li; e ion) with state-of-the-art theoretical methods. (2) The construction of computer programs and calculations on simple molecular-ion/positron systems such as (OH anion; e ion), (CN anion; e ion), and (N3 anion; e ion) within the Restricted Hartree-Fock approximation. (3) Consideration of simple neutral-molecule/positron systems such as (O2; e ion), (H2O; e ion), (NH3; e ion), etc; (4) Exploratory calculations on larger, chemically more interesting, molecule/positron systems using minimal STO basis set calculations (via Gaussian basis sets) within the Roothaan-Hartree-Fock theory. A central feature of these investigations will be a consideration of the annihilation characteristics of these molecule/positron systems. This research represents a continuation of that currently supported by Foundation grant CHE-7610117.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

**3.0005, FEASIBILITY OF THE USE OF DIESEL FUEL, MARINE, AS AIRCRAFT FUEL**

*C.J. NOWACK*, U.S. Navy, Air Propulsion Test Center, *Trenton, New Jersey* 08641 (DN796813)

Determine the suitability or adaptability of diesel fuel, marine (DFM) for emergency use in aircraft gas turbine power plants.

Conduct complete MIL-T-5624 specification tests on samples of DFM to determine the possible problem areas, such as viscosity and density, which could affect the low-temperature starting capability of engines and engine fuel metering equipment. Determine possible effects on ground filtration equipment such as filter/separators and fuel monitors. conduct hot end corrosion and combustor studies for any deleterious effects, and determine the capability of present state-of-the-art aircraft fuel metering hardware to accomodate DFM.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Material Command

**3.0006, DEVELOPMENT OF HIGH-STRENGTH SILICON NITRIDE**

*J.A. PALM*, General Electric Company, *Schenectady, New York* 12305 (DN790017; N00019-77-C-0259)

To develop high-strength silicon nitride for service at 2,500 F and above in naval aircraft gas turbines.

Silicon nitride will be synthesized to provide reactive material of high purity. Minimum amounts of non-oxide compounds such as Be3N2, Mg3N2, or Mg3Si will be added as sintering aids. Pressing procedures will be investigated to yield near-theoretical density bodies.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, DC 20360

SUPPORTED BY U.S. Dept. of Defense, Navy

**3.0007, CROSSED BEAM STUDIES OF EXCITED ATOM COLLISIONS**

*P.E. SISKA*, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (CHE76-84434 A01)

A continuation of the study of metastable rare-gas atom collisions in crossed molecular beams, currently supported by Foundation grant CHE-7403072, is planned. Time-of-flight experiments will allow the measurement of state-to-state absolute differential cross sections for electronic excitation transfer processes in a number of systems. Angle-energy distribution measurements for Penning ionization systems will continue, and they will be extended to include open-shell atom partners and halogen-containing molecules. Elastic scattering in nonquenching metastable atom systems is planned as a means of obtaining unambiguous information on excited-state potentials. Differential scattering measurements in H, N, and O atom systems also will be carried out.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

**3.0008, PHASE TRANSFER CATALYST RESEARCH OF THE DEVELOPMENT OF A NEW CLASS OF CORROSION INHIBITOR**

*OHR*, U.S. Navy, Air Vehicle Technology Dept., *Warminster, Pennsylvania* 18974 (DN781477)

TECHNICAL OBJECTIVE - inorganic salts such as chromates, molybdates, etc., are the most effective corrosion inhibitors for the aircraft metals aluminum, steel, etc. However, these cannot be used to improve the inhibition properties of liquid and solid organic materials for aircraft (paints, plastics, etc.) since the salts are not soluble in such media. Consequently these materials either contain the inferior organic inhibitors, or contain the inorganic salts in the less effective dispersed, not dissolved condition, or do not contain inhibitors at all. The untold man-hours and funds that are spent yearly in replacing corroded aircraft parts attest to the need for upgrading the corrosion protective effectiveness of organic materials. Accordingly, the objec-tive of this research is to devise cheap and facile chemical means to dissolve the superior inorganic inhibitors into the media of organic liquid and solid aircraft materials.

APPROACH - a very recent concept in modern organic chemistry which is being utilized by universities and industry towards solving problems in other chemistry fields will be directed to satisfying our objective. The concept, phase transfer catalysis, refers to the transfer of substances from one phase (e.g., oil) to another (water) by means of certain ammonium and phosphonium salt catalysts (PTC). These will be employed to dissolve and activate high-performance water soluble corrosion inhibitors (above) into the organic media of aircraft materials, and to activate organic inhibitors such as the triazoles beyond their normal performance when they are dissolved in the same media. Some of the PTC salts are cheap and commercially available; others will be synthesized as required to provide compatibility between inhibitor and liquid material. Long-term salt spray tests using representative metals will test the feasibility of the idea.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**3.0009, RESEARCH INITIATION - SURFACE EFFECTS ON THE MECHANICAL BEHAVIOR OF TITANIUM**

*E.I. SAVAGE*, Univ. of Rhode Island, Graduate School, *Wakefield, Rhode Island* 02881 (DMR78-05427)

The objective of this investigation is to examine in detail some previously observed effects relating surface condition to the bulk mechanical properties of titanium. The effects observed included a drop in flow stress or increase in creep rate in proportion to the applied current for commercial purity polycrystalline titanium undergoing anodic dissolution in an acidic solution. Stress relaxation experiments will be undertaken as a function of purity level, surface cleanliness, and stress reversal. The results obtained are expected to contribute toward understanding stress corrosion cracking processes in metallic materials.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**3.0010, NAVY VEHICLE DESIGN AND CONSTRUCTION - HIGH-PERFORMANCE METAL-MATRIX COMPOSITES**

*H.L. MARCUS*, Univ. of Texas, School of Engineering, *Austin, Texas* 78712 (DN875163; N00014-78-C-0094)

Metal-matrix composites offer promise for use in Navy airframe structures, turbine engines, missiles, armor, penetrators, etc. This research effort is directed towards understanding the structure-property relationships in graphite-reinforced aluminum composites which have demonstrated high strength-to-density properties, but suffer from low transverse strength.

The program is divided into three phases. The first phase will examine fracture behavior in graphite-reinforced aluminum composites. Chemistry of the fracture surface will be related to the fiber-matrix interfaces. The role of residual stress in influencing the fracture will be explored. A fracture criteria will be developed that will be used in the second phase of the program to give directions for structural change of the fiber-matrix interface by thermal treatment to improve transverse strength. The third phase will introduce modifications in the process fabrication variables to improve the mechanical properties further.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**3.0011, RECOMBINATION IN SOLAR CELL MATERIALS**

*P. LANDSBERG*, Univ. of Southampton, *Southampton, England, United Kingdom* (DF462090; AF-AFOSR-3437-77)

Investigate, in detail, the theory and effects of multiphon emission-recombination and phonon-assisted auger recombination of minority carriers in solar cell semiconductor materials.

Review theoretical and experimental information on recombination in semiconductors. Develop multiphon and phonon-assisted auger recombination models and correlate with known behavior. Correlate MP and PA auger with phonon degradation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

**3.0012, QUANTUM CHEMISTRY OF SMALL MOLECULES**
*E.R. DAVIDSON*, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (CHE76-84036 A01)

Davidson will continue his work on potential surfaces and excited states, and begin research in theoretical x-ray photoelectron spectroscopy. Triatomic potential surfaces (especially for excited states) are of great practical interest because of work in plasmas, lasers, and atmospheric pollution. Theoretical calculations of the potential surfaces for several of the more interesting triatomics will aid in building experience in the types of topographic features which can be presented. The HCO radical is of great importance in flames, and calculations of its quite complex excited-state potential surfaces will be undertaken. Similar studies are planned for other triatomic radicals such as HNO, CH2, etc., of importance in hydrocarbon fuel combustion in air. X-ray photoelectron spectroscopy is an important experimental tool in studies of the electronic structure of molecules, but interpretations of the spectra still leave many unanswered questions. Studies are underway on the X-ray extended fine structure of Br2, C12, and F2, and on the satellite structure of ethylene. Projects to be initiated under this grant include application of discrete basis function methods to calculations of intensities of primary spectral peaks associated with core-hole and valence hole states of neon, carbon monoxide, ethylene, and acetylene.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

## ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

**4.0001, MODIFICATION OF M72 IGNITION SYSTEM (GROWLAR)**
*J.C. HODGES*, U.S. Army, Propulsion Directorate, *Huntsville, Alabama* 35809 (DA0G1040)

Modify 50, M-72 rocket motors ignition systems from percussion to electric.

Design, manufacture and test electrical ignition systems for the M-72 rocket motor.

SUPPORTED BY U.S. Dept. of Defense, Army, Missile Research & Development Command

**4.0002, HEAD-UP DISPLAY (HUD) DESIGN**
*R.A. LOHMANN*, Hughes Aircraft Company, *Culver City, California* 90230 (DN781223; N62269-76-C-0231)

To procure a head-up display (HUD) systems study based on new technologies of light generation, light modulation, and holographic optics in order to determine the best course of advanced development for a HUD to be used in naval aircraft of the 1980 era. This contract supports work unit ZA601, Agency Accession No. DN681080.

Initiate a design study to investigate the application of new technologies for HUD systems and present quantified trade-offs of their individual characteristics.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**4.0003, RESEARCH IN SOURCE-CHANNEL CODING AND COMMUNICATION NETWORKS**
*J.K. OMURA*, Univ. of California, School of Engin. & Appl. Sci., *Los Angeles, California* 90024 (ENG77-20799)

Multi-user communication channels, communication networks, source-coding for multi-access channels and channel coding for channels with memory will be studied. Procedures for the efficient utilization of multi-access communication channels and networks will be examined under a variety of practically significant performance measures.

The problems to be investigated are divided into two classes. The first class of problems involves the extension of Shannon's classical channel coding theory for memoryless channels to channels with finite memory. Realistic channels are selected from models of nonlinear bandlimited satellite channels. Source-coding problems for communication networks will be investigated. The other class of problems involves the study of dynamic multiple-access disciplines for multi-access communication channels and networks. Application to computer communication networks, satellite networks, terrestrial radio and line data and voice networks will be considered. Synchronization procedures and adaptive data-compression schemes for communication networks will also be investigated.

SUPPORTED BY U.S. National Science Foundation, Div. of Engineering

**4.0004, LIDAR ATMOSPHERIC MEASUREMENT TECHNIQUES COMPARISON STUDY**
*R.D. HAKE*, S R I International, *Menlo Park, California* 94025 (DN781309; N62269-76-C-4044)

TECHNICAL OBJECTIVE - to evaluate the performance of various active lidar techniques capable of measuring atmospheric properties. This contract supports work unit RG704, Agency Accession No. DN 681244.

APPROACH - perform an analytic study to compare active lidar techniques capable of measuring atmospheric water vapor concentration, temperature, aerosol concentration, wind velocity and turbulance.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**4.0005, ANTENNA MEASUREMENT THEORY AND APPLICATION**
*R.C. BAIRD*, U.S. Dept. of Commerce, Natl. Bureau of Standards, *Boulder, Colorado* 80302 (2765276)

PROJECT OBJECTIVE: Develop, provide and disseminate fundamental measurement techniques, standards, and services essential to users of antennas for space and satellite communications, radar, telemetry, radio navigation, broadcasting, and scientific research. Critical antenna parameters are gain, pattern, polarization, efficiency, etc.

PROJECT APPROACH: Complete evaluation of non-planar near-field measurements through error analyses and comparative measurements. Minimize near-field data and computation requirements, permitting measurement of electrically large antennas and broad-beam antennas. Apply scattering matrix techniques to mutual coupling, interference, and pattern prediction. Extend measurements and standards to MM-waves. Develop stable transfer standards and establish maps. Develop standards and techniques for broadband and impulse response of antennas. Transfer technology to users outside NBS through courses, seminars, publications, cooperative measurement programs, etc.

PRIOR YEAR ACCOMPLISHMENTS: Installed minicomputer in near-field system for data acquisition and monitoring. Developed unified theory for planar and non-planar scanning and efficient probe corrections for cylindrical scanning. Talks and papers on near-field MSMT and analysis, symmetry analysis, and derivation of dyadic Green's functions.

SUPPORTED BY U.S. Dept. of Commerce, National Bureau of Standards

**4.0006, COMMUNICATIONS - SOLAR FLARES AND COMMUNICATIONS**
*R.F. HOWARD*, Carnegie Inst. of Washington, *Washington, District of Columbia* 20005 (DN723093; N00014-76-C-0113)

Navy communications, navigation, long-range detection, and magnetic anomaly detection systems are degraded or completely disrupted by ionospheric and magnetospheric disturbances caused by solar flare activity. The primary goal of this program is to develop an adequate understanding of solar flares to allow prediction of flare activity and the resulting geomagnetic disturbances, by performing research on the physical behavior of magnetic fields on the solar surface, on the interaction between the magnetic fields and solar plasma, and on the effects on the solar wind, the interplanetary magnetic field, and solar-terrestrial relations.

Full disk magnetograms are produced from data collected at Mt. Wilson Observatory and analyzed to yield information on the magnetic field and bulk velocity distributions on the solar surface. High-resolution observations of sunspot regions are utilized to predict solar flares, geomagnetic storms and other solar-terrestrial effects. Analysis on development of flares and solar active regions, on correlation with interplanetary and terrestrial conditions, on the rotation of magnetic elements, and the variation in rotation with solar cycle, and on the large-scale circulation pattern in the solar atmosphere is performed. the existance of solar pulsations will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**4.0007, MICROWAVE INTERACTIONS WITH SEMICONDUCTOR DEVICES**

*T.G. GIALLORENZI*, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN880030)

To investigate the interaction of light with solid state microwave devices so that optical control may be implemented; to study the dynamics of carrier transport in III-V semiconductors and to study carrier relaxation, trapping, mobility in amorphous semiconductors. Through light control of solid-state devices, it is expected that new solid-state device capabilities will result and improved performance from existing devices realized. The Navy has a continuing need for semiconductor devices with improved performance and a hybrid optical/ microwave technology may satisfy these continuing needs.

Using semiconductor lasers and fiber optics, light will be directed onto semiconductor devices to investigate gating, frequency shifting, domain initiation and phase locking. Basic physical interactions will be investigated using picosecond laser sources, optically synchronized electrical switches and semiconductor test samples. Carrier mobility, relaxation, trapping and high field band bending effects will be investigated. Subpicosecond transient effects will be investigated in subsequent studies using mode-locked dye lasers.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

**4.0008, FLUIDIC SEQUENCING OF BALLISTIC SYSTEMS**

*R.K. BRODERSEN*, Martin Marietta Corporation, *Orlando, Florida* 32805 (DN796217; N00174-77-C-0139)

To evaluate/demonstrate the feasibility of utilizing fluidics to obtain longer installed life and improved accuracy and reliability in the sequencing of ballistic systems. This effort is being performed under work unit 4589A, Agency Accession No. DN696206.

The FY 77 fluidic sequencer (FS) effort is directed at greater timing accuracy (plus or minus 2% vs plus or minus 6%) and the development of the safe and arm firing interface with the flueric cartridge initiator (FCI). A vibrating beam oscillator design approach to obtain the higher desired timing accuracy is being pursued. Design integration of the sequencer components to meet escape system geometries is ongoing. In FY 78 the cartridge actuated device (CAD) components will be fabricated and design feasibility tests performed on the all-up fluidic event sequencing subsystem (FESS).

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Ordnance Station

**4.0009, MOTION DRIVE SIGNALS FOR FLIGHT SIMULATORS**

*W.T. HARRIS*, U.S. Navy, Advanced Simulat. Concepts Lab, *Orlando, Florida* 32813 (DN794017)

Develop several methods for calculating motion drive signals in flight simulators and relate them to motion system characteristics, flight maneuvers and training effectiveness.

Select several methods from those found in use or in the literature. Perform a preliminary selection of algorithms to be evaluated for training effectiveness by two selection experiments; the first based on system performance measures (an in-simulator study), the second, a comparison of pilot control activity (in simulator to aircraft). Then evaluate the pre-selected algorithms using transfer of training methods.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Training Equipment Center

**4.0010, DEVELOPMENT OF THE INTEGRATED INSTALLATION NOISE CONTOUR SYSTEM (INCS)**

*J.C. MCBRYAN*, U.S. Army, Constr. Engin. Res. Lab., *Champaign, Illinois* 61820 (DA0V8127)

To develop methods for the facilities engineers and districts to quantitatively predict the noise pollution impact of all major Army operations, including armor, artillery and EOD operations, helicopter operations, small arms ranges, fixed-wing aircraft support operations, vehicular sources, and industrial plants on the civilian and military populations. The prediction will be in the form of 'equal noisiness' l sub dn contours as suggested by the federal EPA and the National Academy of Science to be overlayed on area land use maps as well as the base master plan. User manuals and computer programs will be the products of this research which will yield the integrated installation noise contour system (INCS) capability. (4th QTR., FY81).

For each of the Army noise source types, a data base will be compiled, a noise prediction sub-model will be created and computerized, and the results documented. Blast noise will be handled in work unit 896-03-001. The initial helicopter submodel (FY77) will be computerized (FY79). Existing vehicle noise data sources and models will be reviewed (FY80) and the results incorporated into the INCS program (FY81). Also, homogeneous noise areas and rocket noise will be investigated (FY79) and added to the incs program (FY81). A manual method to combine the contours will be developed and documented (FY77).

SUPPORTED BY U.S. Dept. of Defense, Office Chief of Engineers, Corps of Engineers

**4.0011, INTERNAL AND EXTERNAL BALLISTICS OF MISSILES WITH SPECIAL CONSIDERATION OF JET PLUMES INTERFERENCE EFFECTS DURING LAUNCH & FREE FLIGHT PHASES**

*H.H. KORST*, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DAAG 29-76-G-0209)

Internal ballistics and internal aerodynamics of plume interactions during the early phases of rocket in-tube launching are investigated by analytical and experimental methods. Modeling of the propulsive jet plume by cold, high pressure air follows the theory developed at The University of Illinois to conduct experiments with propellant gases having dissimilar specific heat ratios and chemical composition. Experimental evaluation of these geometrical and dynamic plume modeling concepts is presently proceeding under U.S. government sponsorship at Calspan (USA) and the FFA (Sweden) coordinated by University of Illinois faculty. Extensive computer programs have been developed to support the analysis and the evaluation of experimental data obtained at these large facilities and in the blow-down facilities of the Gas Dynamics Laboratory.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

**4.0012, VIBRATIONAL RELAXATION OF EXCITED SPECIES OF INTEREST TO CHEMICAL LASERS**

*L.H. SENTMAN*, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801

A classical model for vibration-rotation and vibration-vibration energy transfer between two dissimilar diatomic molecules has been developed. For the hydrogen halides, whose relaxation is generally accepted as being governed by V-R energy transfer, the relaxation times predicted by the present theory agree reasonably well with the experimental data. In particular, the temperature dependence of the V-V relaxation times for N2-HI, N2-DI, and N2-HF is predicted. To extend the range of validity of this model to low temperatures (300 degrees K), the theory is being generalized to include long-range attractive forces.

SUPPORTED BY University of Illinois

**4.0013, ANTENNA CONSTRUCTION AND MEASUREMENT**

*UNKNOWN*, Westinghouse Electric Corp., *Baltimore, Maryland* 21203 (DN881234; N00014-75-C-0380)

To determine the upper performance limit of the McDonnell-Douglas V/STOL UHF rotodome configuration.

Evaluate antenna pattern of 12-element antenna mounted on McDonnell-Douglas scale-model aircraft.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

**4.0014, REACTIVE FLOW STUDY**

*O.H. DENGEL*, U.S. Navy, Surface Weapons Center, *Silver Spring, Maryland* 20910 (DN685173)

To study the mixing and reaction kinetics of chemistry reactive fluids.

1) Determine pressure-time history of liquid monopropellants fired in a laboratory test-run. (2) Apply optical holography for investigation of reactive flows.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

**4.0015, LONG-WAVE PROPAGATION STUDY**

*E.L. MCGANN*, Megapulse Incorporated, *Bedford, Massachusetts* 01730 (DF903250; F19628-77-C-0233)

Air Force function - communications, navigation. Deficiency/Opportunity - improve the range, reliability and survivability of VLF/LF communications. Improve the accuracy, predictability, and reliability of VLF (OMEGA) and LF (LORAN) navigation systems. Objective - to provide long-wave propagation data and the development of new electromagnetic techniques which will significantly advance low-frequency radio propagation technology for Air Force communications, navigation and detection systems. How research contributes - provide the high-resolution experimental and theoretical information required to minimize deficiencies in existing systems, extend the range and reliability of survivable communications, and improve the accuracy of VLF and LF navigation systems.

APPROACH - to extend the range and improve the signal-to-noise in VLF/LF communications systems. The contract will utilize state-of-the-art balloon and rocket techniques to measure transverse electric (TE) and transverse magnetic (TM) signals as a function of altitude, range and path conductivity. To evaluate the survivabiltiy of emergency communications and VLF navigation systems, the RADC/ETEE high-resolution ionosonde will be operated to determine lower ionosphere reflectivity under severe disturbance conditions. To improve ground wave navigation accuracy a study of errors due to unknown ground conductivity and terrain irregularity scattering will be conducted utilizing the RADC/FTEE LF short-pulse transmitter.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

**4.0016, NONPOTENTIAL AERODYNAMICS FOR WINDMILLS IN SHEAR-WINDS**

*L. MORINO*, Boston University, School of Engineering, *Boston, Massachusetts* 02215 (E(49-18)-2415)

The objective of this new work is to exercise and assess the computer programs by comparing them against existing results regarding the effects of noncoaxial wind shear and tower shadow and existing calculations of the generalized forces for flutter analysis. (ERDA-77-32)

SUPPORTED BY U.S. Dept. of Energy, Div. of Solar Technology

**4.0017, NATURAL LANGUAGE UNDERSTANDING BY COMPUTERS**

*W.A. WOODS*, Bolt Beranek & Newman Inc., *Cambridge, Massachusetts* 02138 (DN775469; N00014-77-C-0371)

This task has the interest both of: (1) facilitating computer understanding and processing of unformatted English language test, and (2) improving man-machine interaction by permitting the inputting and retrieval of computer stored data via a natural language dialogue. The task goal is to extend beyond current natural language understanding systems to build a computer intelligence for making comparisons and drawing analogies across narrative data, or forming generalizations across information sources. Examples of the utility of the described capabilities include computer processing of intelligence and pilot debriefing reports.

Contractor will initially develop a theoretical framework for computer representation and use of basic, common-sense knowledge about people, places, objects, and mental abstractions. This framework will become part of an evolving test bed system for evaluating alternative representational conceptions and inferential algorithms for natural language processing by machine. Contractor will demonstrate and conduct experiments on natural language mechanisms for: (1) computer representation of unformatted English language test, (2) machine inferencing, (3) parsing, and (4) criteria for forming associations across data elements/items to permit generalizations and analogies. The task will utilize a data base of unclassified intelligence and pilot debriefing reports.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**4.0018, INFORMATION FLOW IN LARGE-SCALE SYSTEMS**

*Y.C. HO*, Harvard University, School of Arts & Sciences, *Cambridge, Massachusetts* 02138 (DN775635; N00014-77-C-0351)

The military is faced with a number of large-scale systems problems. Examples include command and control systems, computer communication, networks logistics systems and distributed control systems. This task is aimed at understanding the problems of information flow in such large-scale systems so as to improve performance.

This task will combine elements of information theory, computer science, stochastic control theory and operations research to better model and understand information flow in large-scale systems.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**4.0019, HEAT TRANSFER AND FLOW CHARACTERISTICS IN NAVAL THERMAL CYCLES**

*E.R. ECKERT*, Univ. of Minnesota, School of Engineering, *Minneapolis, Minnesota* 55414 (DN823027; N00014-76-C-0246)

The objective of this research is to understand and be able to predict accurately localized heat transfer and flow characteristics of working fluids in thermal systems, particularly heat exchangers and gas turbines, for the propulsion of naval ships and aircraft. This capability is particularly important in achieving higher temperatures and therefore increased thermal efficiencies and specific powers, with reliability, in naval propulsion systems.

Theoretical and analytical techniques are sought, based upon experimental data, to understand local heat transfer and flow characteristics in gas turbines and heat exchangers. Experimental techniques utilized include laser Doppler anemometry and napthaline sublimation for the measurement of flow velocities and heat transfer rates.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**4.0020, MAGNETIC TAPE RECORDING SYSTEMS (THREE)**

*J. BRADLEY*, Scientific Recording Syst. Inc, *Albuquerque, New Mexico* (DN681278; N62269-75-F-6434)

Fabricate three (3) Mark IIB data acquisition systems. The magnetic tape recording system, model 2311S, is used in the system to record flight loads information. These data are used to update aircraft design criteria. This contract supports work unit ZA101, Agency Accession No. DN681080.

These recording units are production models and have been flight tested by NADC. The tape outputs are computer compatible. Each unit can record up to 40 channels of data.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**4.0021, HYDRAULIC DIAGNOSTIC MONITORING SYSTEM**

*J. DUZICK*, Grumman Corporation, *Bethpage, New York* 11714 (DN881348; N62269-78-C-0041)

Develop an on-board diagnostic and condition monitoring system for military aircraft to continually monitor and report failures upon landing.

Sensors and readout panel will be constructed and installed in an a 6 type aircraft for flight test and demonstration.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**4.0022, AMTI RADAR CONCEPTS**

*J.S. SHUSTER*, U.S. Air Force, Rome Air Development Ctr., *Rome, New York* 13440 (DF902830)

AF function - surveillance. Deficiency - slow-moving vehicles cannot be detected in a high-clutter environment and large stationary discrete targets cause false alarms in AMTI systems. Objective - to develop radar techniques for long wavelength radars to find slowly moving vehicles in a high-clutter environment. Also develop an airborne surveillance radar for finding airborne targets that uses a simple inexpensive phased array antenna system that is fixed with respect to the aircraft. How research contributes - work will provide the base for radar techniques for finding slowly moving targets using long wavelength radars. Arrested synthetic aperture radar (ASAR) in which two synthetic aperture maps formed from separate antennas displaced along the flight path are coherently subtracted, and tuned synthetic aperture radar (TSAR) which uses the difference in the Doppler-Doppler-rate relationship of fixed and moving targets to cancel clutter. A third method, the null filter mobile radar (NFMRAD), which uses antenna nulls complementary to Doppler filters to cancel large discretes, is being investigated.

The approach used in all three studies is to first conduct an analytical investigation to determine theoretical radar performance. The second step is computer simulation. The final step is experimental verification. An x-band model radar has been constructed and mounted on a truck which will be used to simulate platform motion. Raw video will be digitized and these concepts will be demonstrated by real-time processing on a digital radar signal processor.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

**4.0023, RELIABILITY OF INSULATING FILMS**

*D.R. YOUNG*, Internat. Bus. Machines Corp., *Yorktown Heights, New York* 10598 (DF901770; F19628-76-C-0249)

AF function - the objective of this contract is to improve the reliability of thin-film insulators used in integrated circuit MOS devices. Deficiency - failure of these devices is due to the buildup of charge in the thin gate insulator which decreases the breakdown voltage of MOS field-effect transistors. How research contributes - improvement of the properties of insulating films will make possible increased reliability and improved performance of integrated circuits used in Air Force and military electronics systems.

The photo I-V technique will be used to determine the location of trapped holes and electrons in silicon dioxide. The detrapping behavior of holes and electrons will be studied by optical, thermal, and high field excitation. The mobility of holes will be measured using the shallow buried junction technique, and the relationship of trapped holes to electrical breakdown studied. The reference of chemical impurities and oxide processing conditions on the trapping of holes will also be studied. Using the avalanche injection technique, the electron trapping in silicon dioxide as a result of ion implantation will be studied. Accurate measurements of thickness versus time during film growth will be made using an in situ ellipsometer. The metal-silicon dioxide interface will be investigated by the field-dependent threshold technique.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

**4.0024, RESEARCH INITIATION - A STUDY OF DUAL RESONANCE IN HAMILTONIAN SYSTEMS**

*D.L. RICHARDSON*, Univ. of Cincinnati, School of Engineering, *Cincinnati, Ohio* 45221 (ENG78-05536)

The problem of resonance in Celestial Mechanics is to be considered for dynamical systems which possess simultaneously two commensurabilities among the frequencies of motion.

The system Hamiltonian H is assumed to have only two critical arguments so that canonical perturbation methods can be applied to reduce the system to a two degree of freedom form. A solution for the motion within the regions of dual-deep resonance will constitute the major objective of the research. Some consideration is to be given toward the construction of a regularized solution which is valid both inside and outside the dual-deep resonance regimes.

The theory will be applied to specific problems in artificial satellite theory. The problem of the motion of a geosynchronous satellite with an orbital inclination close to the critical value of 63 degrees will be the subject of one such application.

SUPPORTED BY U.S. National Science Foundation, Div. of Engineering

**4.0025, TIME-DEPENDENT HYPERSONIC VISCOUS INTERACTIONS**

*E. RESHOTKO*, Case Western Reserve Univ., School of Engineering, *Cleveland, Ohio* 44106 (DF051540; AF-AFOSR-3562-78)

AF function - aerospace vehicles. Deficiency - lack of knowledge of effects of free stream turbulence on boundary layer stability behavior. Objective - to develop analytical procedures for predicting boundary layer transition due to blunt tip vehicle configurations. Also, evaluation of the influence of test facilities on boundary layer transition at supersonic and hypersonic speeds will be accomplished. How work contributes - this research is part of a comprehensive program in turbulence and turbulent flow to provide a better understanding of the phenomena so that the effects can be considered in the design of advanced aerospace vehicles.

The disturbance equations of a blunt supersonic vehicle will be studied analytically to evaluate the effects of bluntness on the stability of the vehicle boundary layer. Also, the influence of the test facility on boundary layer transition will be studied.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

**4.0026, H. E. PROJECTILE PROTECTION DESIGN CRITERIA VALIDATION**

*G.W. DUCKER*, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF141800)

Most of the source material used in the development of the general specification and design guide of contract F33615-76-C-3006 is unverified or derivative information. This work unit will provide direct verification of the contents of these documents, or the basis for their revision. This will insure that the documents are both effective and sufficient for their intended use. The objective of this work unit is to evaluate the design guidance developed under this contract, validate the requirements and design procedures delineated in the documents and define any necessary modifications. The result of this work effort will be assurance that the standardization documents are adequate for procurement and design, and that the protection requirements are sufficient.

A test plan will be prepared which will reflect the requirements established in the system specification. Test specimens will be prepared in accordance with the design guide. Ballistic tests will be performed in the aircraft survivability research facility, with threats up to and including 57mm HE-T rounds. The results will be analyzed and appropriate modifications made, as necessary, to the specification and design guide developed under the referenced contract.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

**4.0027, MECHANICAL INSTRUMENTATION AND TEST ARTICLE DEVELOPMENTS**
*F.W. LITTLE*, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF141550)

The design and performance of advanced military flight vehicles, manned reentry and ballistic missiles can be seriously affected by the aerodynamic characteristics and the flow field surrounding these vehicles. This influence can be validated by testing these vehicles in aerodynamic ground test facilities. The problem is one of precision measurement of such aerodynamic parameters, from these facilities and test models, as force, moment, pressure, temperature and heat transfer rates. This effort is to develop new techniques for model and instrumentation system designs, fabrication and utilization to provide cost-effective methods to produce accurate aerodynamic test data. Improved aerodynamic ground test capability will provide for more timely and cost-effective development of advanced military flight vehicles and hardware.

Analytical and experimental studies will be made of present techniques, to compare and evaluate factors to improve reliability, accuracy and system response. Test model inspection, utilizing a 3-axis measuring machine and computerized data reduction techniques, will be further developed to increase data accuracy and reduce the time to obtain the data. Low-cost model design and fabrication techniques will be investigated. Specialized instrumentation will be developed for the nine-inch advanced transonic wind tunnel test section development program.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

**4.0028, STRESS MEASUREMENT IN PARACHUTE CANOPIES UNDER BIAXIAL LOADING**
*H.G. HEINRICH*, Univ. of Dayton, Graduate School, *Dayton, Ohio* 45409 (DF142080; F33615-76-C-3145)

Current design practices for textile type canopies used in parachute recovery systems incorporate significant safety factors to account for the stresses resulting from dynamic loadings during the parachute opening process. As a result, parachute canopies are excessively heavy and bulky due to the required materials strength. The objective of this program is the development of a direct stress measurement technique for acquiring biaxial stress data on parachute canopies. The data acquired and engineering tools developed will contribute to the design of lighter and more reliable parachute recovery subsystems for AF weapons systems.

Model parachute canopies shall be instrumented with Omega stress transducers and the circumferential and radial stresses shall be measured during wind-tunnel tests. Measured values shall be compared with the values calculated by existing parachute stress analyses.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

**4.0029, DEVELOPMENT OF FLAT CABLE FOR POWER DISTRIBUTION**
*J.D. SEGREST*, U.S. Navy, Air Vehicle Technology Dept., *Warminster, Pennsylvania* 18974 (DN881153)

To develop the information required for the optimum design of lightweight power distribution busses for use in aircraft employing composite structures.

Previous studies have indicated that a two conductor flat electrical bus will provide improved performance over the conventional power bus. Samples of flat busses will be procured and subjected to laboratory test and evaluation to verify, modify or extend previously developed design algorithms that were based on analytical studies. These algorithms concern feeder inductance, resistance, thermal radiation, power loss, insulation properties and distributed capacitance and inductance for EMI and spike suppression. The design algorithms once verified and/or refined will be used for the design of power distributed systems for specific aircraft configurations.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

**4.0030, SUPERSONIC JET MIXING**
*R.P. RHODES*, Arnold Research Org. Inc., *Tullahoma, Tennessee* 37389 (DF421055; F40600-77-C-0003)

The ability to predict IR radiation emitted from low-altitude rocket plumes is of importance to AFFTD, AFRPL, and other DOD agencies. An accurate analytical model of plume fluid mechanics, afterburning, and radiation is required. A major unresolved question in the modeling of supersonic jet mixing with an external stream is the effect of density gradients resulting from compressibility as opposed to those caused by temperature or molecular weight difference. Cold jet experiments using the same apparatus as the rocket plume mixing tests would help resolve these and other questions and greatly broaden the data base for testing the validity of analytical models.

An experiment will be designed and conducted to measure the flow field properties of a cold jet discharging into subsonic and supersonic streams. Necessary hardware modifications will be designed and fabricated. Static and total pressure, temperature, and species concentrations will be measured at several axial stations in the flow field. The data will be reduced to radial profiles of velocity, jet species concentration, and total enthalpy and compared with various models of 'Mach number effect'. The validity of these models will be assessed to formulate a more correct model.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Arnold Engineering & Development Center

**4.0031, ORBITS FOR NAVIGATION FROM THE MOON TO A SPACE COLONY**
*R.A. BROUCKE*, Univ. of Texas, School of Engineering, *Austin, Texas* 78712

DESCRIPTION: A large number of orbits have been studied and classified in order to travel efficiently from the moon to a space colony that could be stationed at one of the four equilibrium point L1, L2, L4, and L5. The main purpose of this is to find the best compromise between low fuel consumption and fast transit time.

SUPPORTED BY University of Texas

**4.0032, SURVEILLANCE - SUPERCONDUCTIVE ELECTRONICS**
*B. DEAVER*, Univ. of Virginia, School of Arts & Sciences, *Charlottesville, Virginia* 22903 (DN775534; N00014-77-C-0440)

The objective is to study the properties of superconducting microbridge devices using the Josephson effects for millimeter wave mixing and for new types of infrared detectors and optically controlled fast digital devices of interest to the Navy for surveillance.

A millimeter wave mixer operating above 100 gHz will be built using superconducting niobium variable thickness microbridges. Its properties will be characterized by measurements of the DC I-V curves for various values of temperature, magnetic field and incident microwave power. The interaction of a Josephson junction microbridge-type device with a semiconductor substrate will be studied as a function of type of semiconductor, type of impurity dopant, temperature, magnetic field and intensity and wavelength of light irradiating the junction region. An on-line computer/controller with be used to record I-V curves, perform signal averaging for systematic study of the variations of curve features as functions of external variables.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

## GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

**5.0001, PLANETARY CARTOGRAPHY**
*R.M. BATSON*, U.S. Dept. of The Interior, Geological Survey, *Flagstaff, Arizona* 86001 (9580-01453)

The objective of this project is to prepare shaded relief, albedo, and/or contour maps of the planets and natural satellites with various kinds of remote sensing data (mostly digital television pictures from Mariner and Viking spacecraft). An airbrush series of lunar maps will continue. Systematic mapping of Mars will continue, along with revision of existing maps where appropriate. Compilation of special-purpose maps of all planets for topical studies will continue.

SUPPORTED BY U.S. Dept. of the Interior, Geological Survey, Geologic Div.

**5.0002, ECOLOGY, IMPACT, AND CONTROL OF ROOT PATHOGENIC FUNGI OF FOREST TREES**

*F.W. COBB*, Univ. of California, Agric. Experiment Station, *Berkeley, California* 94720 (0061442; CA-B0-PPA-2800-MS)

OBJECTIVE: Determine the impact of major forest tree root pathogens, F. Annosus, V. Wagenerii and A. Mellea, on the forest ecosystem and the important ecological factors and interactions that influence the incidence of these root pathogens. Develop effective control strategies for these pathogens.

APPROACH: Survey several areas of the state to locate infection centers through aerial photography and ground checking and make epidemiological studies of these areas taking into account all aspects of the environment and develop control strategies from this information.

PROGRESS: Pisolithus tinctorius, an ectomycorrhizal fungus, has been found on Douglas fir, ponderosa pine, white fir and red fir in northern California. This is the first record of P. tinctorius on red and white fir. Inoculations with P. tinctorius were made on white fir, ponderosa pine and Douglas fir in a forest tree nursery. Inoculations of roots and rootlets of naturally occurring ponderosa pine trees with Verticicladiella wagenerii were successful when made in the late fall and early spring. Infection of unwounded rootlets, but not of wounded rootlets, occurred. Both wounded and unwounded roots (greater than 5 mm) became infected. Examinations of naturally infected trees indicated that about 10% of the ponderosa pines had recovered from previous infection by V. wagenerii, but sometimes these trees are subsequently infected by Polyporus schweinitzii. In cooperation with R-5, WSFS, pole-size white firs on 6 40th acre plots were uprooted. Dead roots were found in 5 of 99 root systems. Fomes annosus and Armillaria mellea were infrequently isolated from dead roots, but 30 of 52 stump discs showed F. annosus. This suggests that F. annosus may be prevalent without symptoms in pole-size firs.

SUPPORTED BY U.S. Dept. of Agriculture, Cooperative State Research Service, California

**5.0003, ANALYSIS OF STRATOSPHERIC TRANSPORT PROPERTIES**

*G.D. NASTRON*, U.S. Natl. Aero. & Space Adm., Ames Research Center, *Moffett Field, California* 94035 (DF580480)

AF function - environmental impact statements (EIS) of high-altitude Air Force operations. Deficiency - current or anticipated AF operations in the stratosphere and upper troposphere may deposit harmful materials and it is important to assess the potential impact of this. Objective - analyze archived meteorological data of winds, ozone and temperature, 30 to 60 km, and derive eddy diffusion coefficients and ozone flux values. How work contributes - this work will provide improved eddy diffusion coefficients and ozone flux values required for environmental model verification and evaluate lifetime of pollution in the stratosphere.

The statistics of observed winds obtained from rocket soundings are used to estimate eddy diffusion coefficients. Horizontal diffusivity can be estimated from variance of the meridional wind and its integral time scale. Vertical diffusivity is estimated from the wavelengths of the small scale disturbances observed in the mean wind profile. The ozone transient eddy flux values required for model verification will be obtained from ozonesonde data correlated with the wind data. The mean flux can be computed directly from the ozone data.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

**5.0004, RECREATIONAL FISHERIES**

*J. SQUIRE*, U.S. Dept. of Commerce, La Jolla Laboratory, *San Diego, California* 92037 (SWC-017)

Problem need--to develop basic fishery biological information and physical research techniques, provide analysis of data for the dynamic management of both commercial and recreational fishery resources, and to provide coordination of center activities relative to recreational fishery groups. Primary emphasis is on: 1) further development of pelagic fish monitoring methods in association with other measurement techniques as sonar for defining in a real-time mode the distribution and abundance of pelagic resources off the coast of California and Northwestern Mexico. These activities involve the continuing aerial fish spotter resource monitoring program and the conduction of experimental independent surveys testing aerial remote sensing techniques in combination with new methods of measurement to better define the magnitude of several pelagic species resources such as the Northern Anchovy, Pacific Bonito, Jack and Pacific Mackerel, 2) continued studies to determine the coastal and oceanic migratory patterns and annual catch rites of Billfish and other important marine recreational species, in cooperation with the International Game Fish Association and several foreign countries, and 3) on providing a continuing liaison between the center and the recreational fisheries representatives.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Marine Fisheries Service

**5.0005, REMOTE SENSING OF OCEAN PROPERTIES BY MEANS OF VISIBLE LIGHT**

*R.W. AUSTIN*, Univ. of California, Scripps Inst. of Oceanography, *San Diego, California* 92038 (7-721; 04-6-158-44033 MOD. NO. 4)

OBJECTIVE: To digitally process and analyze aerospace multispectral scanner and concomitant in situ oceanic data for the development of mathematical models relating apparent-high-spectral resolution radiances of the ocean to primary productivity, phytoplankton stock, chlorophyll-a, dissolved organic material and other suspended particulates.

APPROACH: Multispectral scanner data from aircraft-borne sensors, with supportive in situ physical, biological, and optical ocean measurements have been acquired over ocean waters containing various phytoplankton, and inorganic suspended particulate concentrations. The reduction, analyses and interpretation of these data will be incorporated into theoretical models, and computer analyses will be conducted in respect to 1) the determination of oceanic and atmospheric factors affecting the signal available to a remote ocean color sensor; 2) establishing methods for the determination of atmospheric path radiance and transmittance from shipboard measurements; 3) the development, refinement and application of computer programs for processing data (remotely acquired and in situ for modeling the optical properties of the ocean and atmosphere), and for algorithmic calculation of sensor data to maximize extraction of quantitative chlorophyll-a and total suspended particulate concentrations; and 4) improving spectral classification of ocean water types based on multivariate analysis of spectral irradiance data.

PROGRESS: Progress to date includes: the development and construction of oceanographic instrumentation for measuring the relevant optical properties of ocean waters; the preliminary development and construction of shipboard instruments for the determination of important atmospheric properties; the development and utilization of experimental techniques for performing surface validation measurements; the development and utilization of computer techniques for the reduction and analysis of oceanic and atmospheric data; the acquisition of a shipboard computational capability interfaced directly with in-water instruments to allow the near real-time assessment of ocean data; the acquisition of computer hardware necessary for the scanning and reduction of aircraft or satellite data; the performance of oceanographic surface validation experiments and the development of techniques for relating upwelling signals from the ocean to the apparent signals available. (Text Abridged)

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Environmental Satellite Service

**5.0006, METEOROLOGICAL PHYSICS**
*BEAN*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8AC42001)

PROJECT OBJECTIVE: Conduct studies of the atmospheric boundary layer, its microstructure and turbulence, utilizing mainly airborne techniques.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Labs.

**5.0007, TECHNICAL FLIGHT OPERATIONS**
*J.D. MCFADDEN*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8G172146)

PROJECT OBJECTIVE: Provide for salaried support costs for pilots and flight crews. Also provides for flight operations support costs.

CURRENT YEAR PLAN: To operate 1 C-130 acd 2 P-3's in support of Stormfury Zero air-sea interaction and fisheries research and lightning suppression program.

PROGRESS REPORT: Flew over 570 hours in supporting hurricane research, NASA Titan III C launch programs, P-3 instrumentation program, porpoise observation, physics research, training, testing, and calibration.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Labs.

**5.0008, GLOBAL MAGNETISM - GM**
*J.C. CAIN*, U.S. Dept. of The Interior, Geological Survey, *Denver, Colorado* 80225 (9780-01754)

Definitive computation of geomagnetic field. This will include analysis of Russian and U.S. satellite magnetic data, incorporation of surface magnetic survey data and definition of transient variations due to external causes. Numerical analysis is to be done on both a global scale and by local functions to define the surface field to a scale down to 1 km.

SUPPORTED BY U.S. Dept. of the Interior, Geological Survey, Geologic Div.

**5.0009, MEASUREMENT OF EMISSION CROSS SECTIONS OF IMPORTANCE IN THE UPPER ATMOSPHERE**
*B. VANZYL*, Univ. of Denver, School of Arts & Sciences, *Denver, Colorado* 80210 (ATM76-80282 A01)

This grant funds experimental measurements of emission cross sections of importance in the upper atmosphere. Energy-variable atomic beams of electrons, protons, and hydrogen atoms, will be used to investigate light emissions resulting from their collisions with typical atmospheric atoms and molecules. While the emphasis will be on hydrogen atom and proton scattering, an electron beam is included in the system for absolute calibration of the optical detectors. This provision also allows direct comparison of certain light emissions from target molecule excitations by the three projectile species in the same system under identical conditions. The projectile energy range covered will be from a few keV on down, an important range in the atmosphere, and one for which the existing information is sparse or altogether lacking.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

**5.0010, STRATOSPHERIC DATA EVALUATION**
*UNKNOWN*, U.S. Dept. of Commerce, Natl. Meteorological Center, *Washington, District of Columbia* 20023

OBJECTIVE: To determine the compatibility between various types of stratospheric data (radiosonde, rocketsonde, SST observations, and satellite) in order that the information can be logically and confidently used together in the various analysis systems.

STATUS: (1) A new large-scale study to determine the compatibility of radiosonde data at all atmospheric levels has been initiated; the results will be used to derive a new operational temperature/height adjustment scheme and to aid in the derivation of error functions for the planned optimum interpolation analysis system. (2) Adjustments for rocketsonde data derived from intercomparison series at Wallops Island and Kourou, French Guiana are being updated from results of other recent tests at Wallops Island (this most recent experiment was conducted to test changes to the U.S.S.R. system). (3) Differences between satellite data (from VTPR-HIRS-PMR-LRIR) and in situ observations are being continually evaluated and results fed back to various satellite experimenters and NESS personnel. (4) Differences between SST observed temperatures (AIDS system) have been evaluated and found to be consistent with radiosonde and inconsistent with VTPR data.

PLANS FOR FY78: (1) Results of the latest radiosonde compatibility study will be evaluated and the data addustment scheme used for 100 mb and above will be updated as necessary. Results of the troposphere will be utilized within the Development Division for optimum interpolation error function calculations. (2) Rocketsonde intercomparison data from the latest Wallops experiments will be used to update the rocket data adjustment scheme. (3) Satellite data from all temperature profile instruments will continue to be evaluated. Of particular importance will be the initial data from TIROS N. (4) An attempt will be made to obtain SST flight data on a real-time basis for inclusion in the 100-mb chart analysis. Evaluation of the data will continue with respect to satellite and rawinsonde reports.

Part 8 of 9.

SUPPORTED BY U.S. Dept. of Commerce, National Weather Service, National Meteorological Center

**5.0011, INTERPRETATION OF ARCTIC AIRBORNE GEOPHYSICAL INVESTIGATION**
*P.R. VOGT*, U.S. Navy, Acoustics Division, *Washington, District of Columbia* 20375 (DN780029)

To combine the various aeromagnetic data sets acquired by the U.S. Naval Oceanographic Office and Naval Research Laboratory into a single data file; to display these and other data on standard arctic projections using digital plotters. Displays will include (a) profiles of residual intensity along the track; (b) residual annotated along track and contoured; and (c) 'zebra-stripe' representations. To compare U.S. Navy data with Soviet 'zebra-stripe' depictions; to assess the accuracy and data density of Soviet work. To develop or adapt software for computing depth to magnetic basement, magnetizaton x layer thickness and rotation of crustal isochrons defined by magnetic lineations; to apply these techniques to the Arctic data set.

Since large amounts of graphic output are needed, the approach will be to massage and display the data on-line using a 'small' computer. The first step will be to convert all software and arctic data tapes. Later analyses may require use of the new NRL TI computer (ASC). If possible, existing programs will be acquired from other agencies doing comparable work.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**5.0012, SOMALI CURRENT EXPERIMENTS**
*W. DUING*, Univ. of Miami, School of Marine & Atm. Sci., *Miami, Florida* 33149 (ATM77-22902)

The objective of this research is to collect observational data that will lead toward a better understanding of large-scale ocean eddies and upwelling zones in the Western Indian Ocean in the vicinity of the Somali Current. This work is a continuation of an ongoing field and data analysis program developed by the P.I. over the past several years in cooperation with a physical oceanographer at the University of Kiel. The data will be collected from a variety of offshore current, temperature and tide gauges. These in situ measurements will be supported by (remote) satellite derived measurements. The combined observations from the in situ and remote sensing programs will support the study of: (a) the formation and propagation of oceanic anticyclonic eddies and related upwelling zones around 5 degrees N, (b) spatial and temporal scales of eddies and upwelling, (c) the vertical structure of the oceanic flow field and the temperature field, and (d) coastally trapped waves.

The flow and temperature fields in the upper layers of the Western Indian Ocean interact with the atmospheric Asian monsoon circulations in a way that is imperfectly understood. This

research addresses questions which when answered will provide a basis for studying these complex interactions. This research is part of cooperative oceanographic/meteorological work under the Monsoon Experiment (MONEX), a regional subprogram of GARP.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

**5.0013, REMOTE SENSING OF FOREST RESOURCES**

*R.M. HOFFER*, Purdue University, Agric. Experiment Station, *Lafayette, Indiana* 47907 (0032384; IND059030)

OBJECTIVE: Analyze multispectral/multi-temporal scanner data from satellite altitudes, registered to supplimental data sets, and develop a set of computer-aided techniques that can be used in a repeatable, cost-effective manner to obtain maps and acreage estimates of forest and other natural resources features.

APPROACH: Utilize Landsat, Skylab, and other multispectral scanner data. Analyze spectral data characteristics and test several techniques for computer-aided analysis of multispectral, multi-temporal scanner data. Digitally overlay and register topographic, soils, and land ownership data onto Landsat scanner data. Define most effective techniques to obtain various types of map outputs requested by resource managers.

PROGRESS: Significant advances were made during the past year in the utilization of LANDSAT satellite data and computer-aided analysis techniques. Techniques were developed to digitally register and overlay LANDSAT data with topographic data (elevation, slope, and aspect). This allowed 1:24,000 scale quadrangle maps and acreage tabulations to be generated for various combinations of cover types and topographic parameters. As part of a NASA-sponsored LANDSAT-II project, a number of these maps were provided to Region 2 U.S. Forest Service personnel for evaluation and use in their planning and management programs. Cover type or land use maps were also generated for a portion of the Wayne-Hoosier National Forest in Indiana and provided to U.S. Forest Service personnel for evaluation and use. In a cooperative project with the Indiana Department of Natural Resources, forest cover types were also mapped using LANDSAT satellite data and computer analysis techniques for a coastal wetlands area in N.W. Indiana. These maps were produced on a Calcomp plotter; thereby allowing the user-agency to specify the scale of the output product desired. The evaluation by Indiana Department of Natural Resources indicated these maps had approximately 86% accuracy. Further testing of effective methodologies for analyzing the satellite data and for evaluating the cost-effectiveness of such techniques is underway.

SUPPORTED BY U.S. Dept. of Agriculture, Cooperative State Research Service, Indiana

**5.0014, WINTER WHEAT YIELD MODEL FROM SURFACE AND SATELLITE METEOROLOGICAL DATA**

*A.M. FEYERHERM*, Kansas State University, Agric. Experiment Station, *Manhattan, Kansas* 66502 (0067086; KAN-05-392)

OBJECTIVE: Adapt the Canadian multiplicative type weather-spring wheat yield model to winter wheat conditions in Kansas and other Great Plains States; test the ability of such model to predict point and area-wide (including State) yields at various stages of growth; and test its usefulness in estimating the variance of area-wide wheat production over years due to weather alone. Provide ground truth information and data reduction of ERTS imagery at two locations in Kansas.

APPROACH: The Canadian model will be used to obtain model derived wheat yields using past historical meteorological data to compare with past observed yields. The model will be modified to reflect effects of diseases, insects, fertilizers, improved varieties, and management practices. Attempts will be made to improve predictive power of model using satellite-derived data.

PROGRESS: Winter and spring wheat yield models have been developed which can be applied universally throughout the Great Plains of the United States to estimate average yields over specified regions. Applicability of the models to other wheat-growing areas of the world will be tested. The models use precipitation, minimum, and maximum temperatures, daylength, and Q(0) (solar radiation at the edge of the atmosphere) as primary daily inputs. Seasonal inputs for a given region include amount of added nitrogen, percent fallowed, varietal yielding ability, and a management and soil productivity factor. Regional inputs include long-term average daily temperature in January and average date when fifty percent of the crop is planted. Robertson's biometeorological time scale and Baier and Robertson's versatile soil moisture budget were used extensively in deriving weather-related variables. Some 1034 experimental plot yields from locations throughout the U.S. Great Plains were used to estimate parameters in the winter wheat model and 306 plot yields from the northern Great Plains were used for the spring wheat model.

SUPPORTED BY Kansas State Government

**5.0015, GEODYNAMICS**

*B. CHOVITZ*, U.S. Dept. of Commerce, Geodetic Res. & Dev. Lab., *Rockville, Maryland* 20852 (836910D0)

In line with a Principal NOS Goal for providing nationwide geodetic control reference points, and the approved objectives of strengthening and adjusting the horizontal and vertical control networks, it is important to be able to obtain extremely accurate super-control points closely monitored for temporal variations in positions as a long-range foundation for these expensive adjustments.

These control points can be provided for by new advanced means of observations. The principal methods being considered are radio interferometry, lunar laser ranging, laser ranging to satellites (in particular, the LAGEOS satellite, launched in May 1976), inertial positioning, and ranging on the Department of Defense Global Positioning System.

Another potential capability of these methods is the possibility of being applicable to conventional first-order field survey work.

The VLBI method has already been chosen for determination of polar motion, and collaboration with NASA is underway. The other methods are being investigated by means of error analyses, and monitoring hardware development.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Ocean Survey

**5.0016, RADIATIVE TRANSFER IN THE ATMOSPHERES OF THE EARTH AND PLANETS**

*W.M. IRVINE*, Univ. of Massachusetts, School of Arts & Sciences, *Amherst, Massachusetts* 01002 (INT76-00643)

Scientists at the University of Massachusetts and the Kanazawa Institute of Technology are cooperating on a study of radiative transfer in atmospheres of earth and other planets. In an effort to define optimum techniques for the determination of atmospheric properties, numerical and analytical aspects of radiative transfer in realistic planetary atmospheres are being studied. In the case of the earth, this study is relevant to weather prediction and the distribution of atmospheric pollutants. In the case of other planets, it is relevant to the interpretation of ground-based and spacecraft observations and the design of future spacecraft observations for the determination of atmospheric thermodynamic properties, aerosol size and composition, and horizontal and vertical atmospheric structures.

SUPPORTED BY U.S. National Science Foundation, Div. of International Programs

**5.0017, CORRELATIONS BETWEEN OPTICAL AND RADIO OBSERVATIONS OF CORONAL HOLES AND ENVIRONMENTAL DISTURBANCES**

*R.C. ALTROCK*, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF580800)

AF function - communications, surveillance, detection, tracking. Deficiency - inadequate knowledge of solar environment, disturbances, and physics limits ability to predict events which disrupt and degrade AF systems. Objective - to determine the correlation between solar 'coronal holes' (regions of unusually low density in the corona), as observed in both the optical and radio regions of the spectrum, and geomagnetic

disturbances. How research contributes - a definite relationship has been discovered between coronal holes as observed in soft x-rays from satellites and rockets, and the source of high-speed solar wind streams. At times of low solar activity these patterns become long-lived and result in recurrent geomagnetic storms. These in turn affect Air Force systems and communications, and are the subject of prediction efforts by the Air Weather Service. Because observations of coronal holes by satellites and rockets are not available continuously, they are not well-suited to ongoing prediction schemes, so AWS requires more regular observations of these phenomena. This work unit will investigate a number of possible ground-based observation schemes, as well as the specific relationship between the time and space location of coronal holes observed by these methods and geomagnetic disturbances. The success of this work unit will result in more reliable predictions of geomagnetic disturbances for AWS. This effort directly supports the task objectives of isolating causes and propagation mechanisms of solar-induced environmental disturbances.

Observations of coronal holes will be attempted in the atomic lines of FexIV 5303A and HeI 10830A, and in the radio spectrum. The present instrument for observing Fe5303 at Sacramento Peak Observatory (SPO) will be upgraded by the addition of a system designed to suppress scattered light from the objective lens and the atmosphere. The suppression instrument will be developed under contract utilizing frontier technology that is untested in this particular application. Techniques for observing He10830 both photographically and phototelectrically will be developed in collaboration with Aura (NSF contractor) personnel at SPO. A feasibility study will be conducted to develop and test a diode-array observing system to produce spectroheliograms in He10830 utilizing an existing instrument at SPO. Radio observations have been obtained. (Text Abridged).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

**5.0018, PREDICTION OF GEOPHYSICAL PHENOMENA INTERFERING WITH COMMUNICATION, SURVEILLANCE, OR NAVIGATION**

*J.P. CASTELLI*, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF581050)

AF function - communications, surveillance and navigation. Deficiency - prediction of interruptions to communications, false alarms in surveillance systems from natural causes, and navigation errors due to insufficient signatures of solar-caused magnetic activity. Objective - to develop and interpret solar radio signatures of magnetic storms and elevated AP. How research contributes - provides prediction of geophysical phenomena in advance of actual occurrence.

Analysis of meter wavelength noise storms preceding magnetic activity suggests a correlation between the two. The approach will be to relate noise storm regions with sources of recurrent magnetic activity by doing a correlation study between solar radio noise in the 100 to 300 mHz range and the geomagnetic index AP. Flux density, duration and bandwidth of noise storm activity will be addressed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

**5.0019, NAVPAC 1-2 AND 3 AND S77-2 SATELLITE DRAG MEASUREMENTS**

*F.A. MARCOS*, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF581190)

AF function - airborne surveillance, target acquisition. Deficiency or opportunity - atmospheric density variations with time and space cannot be adequately predicted. Objective - direct density measurements with new satellite-borne accelerometers. Results are analyzed to obtain improved density data as a function of geomagnetic activity and solar flux. How research contributes - in-flight accelerometer drag measurements permit accurate determination of Air Force system satellite ephemerides. Development of more accurate models permits improved satellite surveillance capability.

New SETA (satellite electrostatic triaxial accelerometer) instruments will be launched on AF satellites. The SETA instrument uses a single proof mass to measure accelerations in three orthogonal directions. This is a completely new development and supersedes the earlier technique of flying three orthogonal uniaxial MESA instruments. Density data will be obtained by determining the drag component along the velocity vector. Attitude will be determined from drag components measured by all three axes. The instrument will also be used to monitor spacecraft orbit-adjust thrusts. Data from the ROCA (rotatable calibration accelerometer) experiment on the S77-2 satellite will be reduced and analyzed to obtain aerodynamic drag measurements in near-circular orbits. The ROCA accelerometer is a single-axis instrument with the capability to rotate the sensitive axis perpendicular to the velocity vector. This technique permits the determination and removal of inherent bias errors and leads to improved accuracy drag measurements. The accelerometer data will be analyzed to determine variability related to geomagnetic activity at a constant local time and the dependence of density on solar flux during a period of increasing solar activity.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

**5.0020, EQUATORIAL SCINTILLATION MODELLING STUDIES**

*J.P. MULLEN*, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF580920)

AF function - communications/navigation. Deficiency - signal fading range errors. Objective - to model the scintillation-producing structure of the equatorial ionosphere in order to predict communication satellite outages and errors. How research contributes - develops and tests predictive models of ionospheric scintillation.

Using actual data from Peru, Brazil and Ghana models are constructed and tested to predict SATCOM outages and error rates. Driving parameters are day number, local time, solar and geomagnetic activity.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

**5.0021, TELEMETRY ANTENNAS FOR LARGE DIAMETER SOUNDING ROCKETS**

*R.E. WILTON*, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF580650)

AF function - sounding rocket telemetry antenna development. Deficiency - antennas currently used for large diameter rocket vehicles are costly to fabricate and integrate into payloads. Objective - to develop low-cost and reliable telemetry antenna systems for large-diameter research rocket payloads. How research contributes - current emphasis on large-diameter rockets, such as the Aries-type, requires improvements in the design of telemetry antenna systems. Varying flight conditions require more than one design approach in order to achieve cost savings while maintaining high reliability. The task objective to improve sounding rocket payload instrumentation systems will be supported by this work. Antenna performance and aerodynamic reliability will be improved. Costs for both antenna construction and for installation into the payload structure will be reduced.

A series of large-diameter Aries-type rockets will be used to provide for testing of several different antenna design concepts. Three different design criteria will be investigated- (1) an aerodynamically shaped flush-mounted system having an omnidirectionally radiation pattern, (2) a surface-mounted antenna that also provides omnidirectional coverage, and (3) a directional antenna system for use with attitude-controlled vehicles. These antenna systems will be based on existing stripline technology. These investigations will lead to providing standard designs for future large-diameter vehicle instrumentation payloads. Antenna designs will provide for more effective telemetry systems for each specific type of rocket vehicle, reduced costs for antenna construction and more economical techniques for installation of antenna systems into the rocket payloads. The time schedule for this work will depend in part on availability of rocket flights for testing. vehicles of opportunity will be used on a 'piggy-back' basis.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

**5.0022, MEASUREMENTS OF ATMOSPHERIC CHLOROFLUOROCARBONS AND NITROUS OXIDE AND INTERPRETIVE AND THEORETICAL STUDIES IN ATMOSPHERIC CHEMISTRY**

*R.J. CICERONE*, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (ATM77-22347)

This research involves both theoretical and experimental studies of atmospheric chemistry. Numerical modeiing investigations of the chemistry and physics of the stratospheric ozone layer and of the non-urban troposphere will be conducted.

Measurements of tropospheric chlorocarbons, chlorofluorocarbons and of nitrous oxide by electron-capture gas chromatography will also be performed. In general, the compounds to be measured are gases that are capable of influencing stratospheric photochemistry and/or the outgoing planetary infrared radiation and they are partly or mostly anthropogenic. To assure proper identificaiion of certain species and to detect several others, a limited amount of cryogenic pre-enrichment mass spectrometric work will be undertaken.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

**5.0023, ATMOSPHERIC INFLUENCES ON ECOSYSTEMS AND SATELLITE SENSING**

*K.N. BROOKS*, Univ. of Minnesota, School of Forestry, *St. Paul, Minnesota* 55108 (0010830; MIN-42-035)

OBJECTIVE: Develop methods for evaluation and utilization of remotely sensed data pertaining to agricultural ecosystems for ERTS and aircraft. Develop improved statistical relationships and analyses of solar radiation and certain other atmospheric variables of fundamental impact on plant growth and yield.

APPROACH: Use remote sensing techniques to provide unlimited capabilities for measurement of hydrologic variables of diverse ecosystems. This has the capability of providing synoptic and repetitive measurements of large areas unattainable from point sampling at the earth's surface. Also provides a unique opportunity to evaluate effects of alternative land management practices on hydrologic characteristics. Satellite data will permit the location and mapping of snow distribution and subsequent zones of melt; will facilitate present research related to predicting snowmelt runoff, and stream flow forecasts will be enhanced. Albedo and energy regimes information will strengthen estimates of evapotranspiration and soil moisture content of diverse vegetation and soil types. Solar radiation data collected at field locations and research sites will be provided for development and testing of statistical analyses. Data will be subjected to previously developed relationships to evaluate effects of meterological variables on forest and water ecosystems.

PROGRESS: Aerial photographs and simultaneous lake-water quality measurements were taken during the summer of 1976 on six different lakes classified from oligotrophic to eutrophic. Different levels of film exposure and processing for film 2402-58 are being studied to determine if film density-water quality correlations can be improved. Study of renovation and reclamation potentials of wastewater irrigation on iron-ore overburden material in northeastern Minnesota has been completed. Renovation of effluent with respect to phosphorus and total nitrogen was observed. The vegetation response will be followed for several years. An assessment of water quality problems associated with forest management activities in Minnesota has begun. Data and spatial mapping methodologies available from the MLMIS and other sources are being investigated. Study sites are being selected in northeastern Minnesota for field evaluations of stream sedimentation, nutrient levels, and other water quality indicators associated with natural runoff events. (Text Abridged)

SUPPORTED BY U.S. Dept. of Agriculture, Cooperative State Research Service, Minnesota

**5.0024, STUDIES OF WAVE-CURRENT INTERACTIONS**

*M.Y. SU*, U.S. Navy, Naval Oceanographic Lab., *Bay St. Louis, Mississippi* 39529 (DN894404)

The initial objective is to collect and analyze experimental measurements of the effects of steady, non-uniform currents on the spectra of progessive wave trains in an outdoor simulation facility. these results will form (1) the basis for the evaluation of existing theoretical wave-current interaction mechanisms, and (2) the semi-empirical foundation for satellite data interpretation techniques applied to the detection of ocean fronts and eddies. Ultimately, the results of this work could lead to the reformulation of global wind-wave forecasting models.

Using the large, controlled-flow channel at MSTL, steady non-uniform water currents will be generated. Surface gravity waves of variable amplitudes and frequencies will be generated by a plunger-type mechanical wave maker. These waves will be directed in upstream, downstream, and slant directions with repect to the current axis. Effects of eddies on wave spectra will be simulated near the right-angle bend of the channel. Time series of current speeds and wave heights at various locations along and across the channel will be measured simultaneously. Wave frequency spectra will then be computed from these time series. The effects of currents on wave height, frequency and refraction will be characterized by comparisons of wave spectra produced.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Ocean Research & Development Activity

**5.0025, ENERGETICS AND CLIMATOLOGY OF THE ATMOSPHERIC GENERAL CIRCULATION**

*E.C. KUNG*, Univ. of Missouri, Agric. Experiment Station, *Columbia, Missouri* 65201 (0057259; MO-00310)

OBJECTIVE: Complex energy transformations of various scales of motion and thermodynamic processes will be studied. Information obtained is to be incorporated in various numerical models of weather and climatic forecasting. Examination of long-range variation of energetics parameters will provide basic information in formulating parametric models of meso-range climatic forecasting. These researches are integral parts of the Global Atmospheric Research Program.

APPROACH: Energy transformation in middle-lattitudes, generation of wave disturbances, subsynoptic scale processes, tropical energy balance, climatological variation of energy parameters and their temporal and spacial coherence will be computed with available upper-air and satellite data.

PROGRESS: With upper-air data on the Atlantic Tropical Experiment, characteristic energetics regimes of planetary waves and cloud cluster disturbances have been distinguished and their interactions in tropical energy cycle revealed. Energy transformations during the air mass transformation in the middle latitudes are studied with heat and kinetic energy budget. Large-scale synoptic disturbances in the middle latitudes are studied in relation to energy sources. Study of basic climatological parameters is continuing. The comprehensive diagnosis of NCAR (National Center for Atmospheric Research) general circulation model has completed the computational phase.

SUPPORTED BY U.S. Dept. of Agriculture, Cooperative State Research Service, Missouri

**5.0026, NAVY ENVIRONMENT - AIRBORNE RADAR PROFILING OF FIRST-YEAR AND MULTI-YEAR SEA ICE THICKNESS**

*A. KOVACS*, U.S. Army, Cold Reg. Res. & Engin. Lab., *Hanover, New Hampshire* 03755 (DN775324; N00014-77-MP-70016)

To develop a method of determining, by remote sensing, the thickness, top and bottom profile, effective dielectric constant, and the electromagnetic impulse velocity of first year and multi-year sea ice, using a dual antenna impulse radar system; and to develop data processing techniques to aid in analyzing and interpreting the data output from the system, and in constructing surface and subsurface reliefs of the sea profiled.

A helicopter-borne dual antenna impulse radar system will be used to profile first year and multi-year sea ice at various altitudes and speeds. Similar profiles will be obtained by ground transport of the radar system for comparative purposes. Numerous drill hole measurements will be taken over the areas profiled, such that actual ice depth can be compared with depth measurements obtained by the system. The data will be recorded on a graphic recorder and an analogue tape, which will then be computer-analyzed to obtain exact signal travel times, from which ice thickness measurements can be calculated. Utilizing this data, techniques for constructing a cross section of the ice profiled, which can be used in model studies of heat exchange between the

ocean and atmosphere, studies of under-ice roughness, oil entrapment, etc., will be developed.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**5.0027, USE OF AIRCRAFT SPECTRORADIOMETRY TO DETERMINE WATER QUALITY**

*H.L. MCKIM*, U.S. Army, Cold Reg. Res. & Engin. Lab., *Hanover, New Hampshire* 03755 (31583)

OBJECTIVE: To quantitatively assess water quality parameters in fresh and salt water regimes utilizing aircraft spectroradiometer data and to conduct laboratory tests to determine spectral bands of interest for quantitative and qualitative measurement of water quality data to meet Corps of Engineers requirements.

APPROACH: A prototype 500-channel aircraft spectroradiometer instrument with a 10 A spectral resolution will be used in the study to assess water quality parameters in reservoir systems. The instrument provides a digital tape readout for 500 channels ranging from the visible (0.42 micron) to the near infrared wavelengths (1.0 micron) for a nominal 60 x 60 ft. area. Aircraft spectroradiometer flights over selected test site areas will be accomplished in conjunction with ground truth data acquisition. Analysis of the high resolution multispectral data will be used to qualitatively and quantitatively assess water quality parameters, especially turbidity, based on correlation to field measurements. Laboratory testing to determine spectral bands of interest will also be conducted with the airborne spectroradiometer instrument.

In addition, theoretical models will be examined that concern the development of spectral response curves based on varying the size, optical properties and density of particulate matter under laboratory conditions. Results from the aircraft flight analyses and laboratory experiments will be compared to conventional techniques. A cost effective comparison between conventional techniques and aircraft spectroradiometry to assess water quality parameters in CE reservoir systems will be made. Development of procedures to assess water quality will be made for use by Corps of Engineers Division/District personnel.

SUPPORTED BY U.S. Dept. of Defense, Office Chief of Engineers, Corps of Engineers

**5.0028, TORNADO MEASUREMENTS**

*S.A. COLGATE*, New Mexico Inst. Min. & Tech., Graduate School, *Socorro, New Mexico* 87801 (ATM76-82562)

The objective of this research is the testing of small instrumented rockets fired from a slow-flying aircraft to make measurements in water spouts, and, potentially tornadoes. The rockets will measure pressure, temperature, magnetic field ionization and electric field with 2.5 meter spacial resolution. The capabilities have already been demonstrated of firing small rockets of 350 grams mass, speed Mach 1.5, accuracy plus or minus .02 radians with adequate receiver telemetry signals strength at 6 kilometers from a slow-flight STOL-equipped Cessna 210 G. Initially, an extensive calibration and flight-testing will be performed in Florida using water spouts as targets. If these are successful, an attempt will be made to investigate tornado targets with the aircraft operation in Oklahoma, Texas and Kansas.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

**5.0029, SCATTERING BY NON-SPHERICAL PARTICULATES 15339-GS**

*D.W. SCHUERMAN*, State University of New York, Graduate School, *Albany, New York* 12203 (DA0F9134; DAAG29-78-G-0024)

To investigate the limits of validity of MIE theory in its application to non-spherical shaped particles. Relevance - scattering and absorption by randomly oriented non-spherical particles is relevant to investigations of smoke/aerosol obscuration, electrooptical sensor performance under low-visibility conditions, remote sensing of atmospheric and terrain parameters, and propagation of the beam of a high-energy laser.

Measure extinction, albedo and scattering matrix of microwave radiation by targets of known shape, size, orientation and refractive properties in the specially designed microwave scattering laboratory. Use an electrodynamic similitude technique to scale from microwave to optical wave.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

**5.0030, SEASAT-A DATA AND OCEAN SURFACE WEATHER ANALYSIS**

*W.J. PIERSON*, City University of New York, School of Liberal Arts & Sci., *New York, New York* 10031 (DN875051; N00014-77-C-0206)

The objective of this program is to assess the particular SEASAT-A data analysis needs of FNWC and to demonstrate how to correct the backscatter attenuation by use of scanning multifrequency microwave radiometer (SMMR), visible, and infrared data to achieve the vector wind field within the swath width at the resolution of the SEASAT-A satellite scatterometer (SASS) approach.

A SEASAT-A simulated data tape will be merged with simulated SMMR, visible, and IR data tapes. These data will then be used to demonstrate the path loss corrections required for the SASS either by simulation or by procedures immediately applicable to SEASAT data. Aliases possible in the SASS data will be determined by using available FNWC analysis and forecast products of conventional data. The FNWC surface analyses of wind and pressure will include the raw spot data as well as analyzed values and contour maps of the data.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**5.0031, A STUDY OF EDDIES ON THE WESTERN BOUNDARY OF THE GULF STREAM**

*F.M. VUKOVICH*, Res. Triangle Institute, *Durham, North Carolina* 27709 (7-134; 7-35182)

OBJECTIVE: To employ satellite thermal-IR data to locate and study dynamic oceanographic features along the eastern seaboard of the U.S. and to demonstrate that the satellite-derived observations can improve the interpretation of standard hydrographic data collected from ships.

APPROACH: Satellite data are received at RTI and monitored until an event (eddy, meander, etc.) is observed in the target area (defined as locations that can be reached during one day of cruising time from Wilmington, N.C.). A research vessel is alerted and the cruise begins within one day of the satellite location of an event. Surface thermal expressions are compared using ship and satellite data for evaluating the reliability of the satellite analysis. Further subsurface data are obtained to study the relationship between the total oceanic feature and what can be monitored by the satellite sensor. Buoys, tracked by satellite, are released in prominent features for monitoring currents and water mass migration.

CURRENT PLANS: Data from ship, drifting buoys, and satellite infrared measurements have been collected during April and May of 1977. The present plans call for the data reduction and evaluation to relate the three data sources to each other and to the motion of the Gulf Stream.

PROGRESS: Initial evaluation of the data collected during April-May 1977 indicates that drifting buoys can provide a very useful addition to the ship and satellite infrared data for the evaluation of Gulf Stream motion.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Environmental Satellite Service

**5.0032, STATEWIDE INVENTORY OF MARINE TURTLES ON NESTING BEACHES AND IN NEARSHORE WATERS**

*S.E. STANCYK*, Univ. of South Carolina, B.W. Baruch Inst. Marine Biol., *Columbia, South Carolina* 29208 (R/BS-1)

OBJECTIVES: Through coordination of coastal aerial surveys, on-board tagging of sea turtles caught in trawler nets, and intensive groundytruth surveys on heavily-nested beaches, we seek to: 1) Provide a quantitative census of the South Carolina nesting population of loggerhead turtles, primarily by refining preliminary estimates made last year by more intensive flights and more detailed ground truth methods. 2) Continue and refine the determination of relative nesting distribution on a beach-to-beach basis, and also on a sector-to-sector basis for each beach. 3) Continue efforts begun during current fiscal year to monitor offshore activity of marine turtles. 4) Maximize cooperative efforts with commercial fisheries and federal and state officials in pursuit of a comprehensive management and research effort for Caretta.

HOW INFORMATION WILL BE APPLIED: After compilation and analysis at the data center, this information will be supplied on an ongoing basis to Glenn Ulrich (Commercial Fisheries) and Ken Stansell (Non-Game and Endangered Species Program) of the South Carolina Wildlife and Marine Resources Department for use in the development of a statewide management research program for this endangered species. Data will also be supplied to the U.S. Fish and Wildlife Service as a basis for the development of regulations applicable to the loggerhead under its inclusion in the federal Endangered Species Act. Distribution of brochures and informal meetings through the Sea Grant Advisory Service will assist Advisory Services and commercial fishermen, and will create a liaison between fishermen and marine scientists studying this animal.

ACCOMPLISHMENTS DURING PAST TWELVE MONTHS: 1. Accomplished 13 flights along the entire South Carolina Coast at one-week intervals from 5/28 to 8/19, 1976. 2. Counted 2,389 loggerhead turtle nesting emergences, 75% of which occurred between Raccoon Key and North Island, inclusively. 3. Documented nesting patterns along the coast, with a peak in nesting on June 20, 1976. 4. Recorded ground truth data on a daily basis on Kiawah Island, and less often on Cape Romain, Dewees and Capers Islands. 5. Determined a need for more frequent flight times and more extensive ground truth in order to obtain statistically reliable results on loggerhead nesting activity.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Sea Grant Office

**5.0033, AGRICULTURAL APPLICATIONS OF SATELLITE ACQUIRED EARTH OBSERVATIONS**

*C.L. WIEGAND*, U.S. Dept. of Agriculture, Agric. Res. Service, *Weslaco, Texas* 78596 (0043879; 7202-20762-003)

OBJECTIVE: Develop and test rapid and timely methods for handling, analyzing, and applying satellite data to agricultural problems over large areas.

APPROACH: Relate satellite indicators of plant residue amount in a wheat-fallow rotation to wind and water erosion susceptibility of soils. Utilize earth surface temperatutes from NOAA (SMS AND GOES) and NASA (HCMM and LANDSAT) C) to: Estimate soil temperatures suitable for planting advisories, determine vegetative ground cover, and estimate soil water conditions and/or evapotranspiration rates. Identify crops and land uses, measure crop acreages, and classify various soil and crop condition categories in the ARS wheat yield prediction effort and joint ARS-SCS wind erosion effort. Merge the spectral indicators of biomass, growing conditions, and stresses with physiological model outputs to improve estimates of grain (sorghum, wheat) maturity date and probable yields on the Great Plains. Inventory rangeland and estimate the harvestable forage. Investigate techniques for distinguishing plants and plant residues from the variable soil background that can aid automated soil mapping and crop discrimination.

SUPPORTED BY U.S. Dept. of Agriculture, Agricultural Research Service, Subtropical Texas Area

**5.0034, ENERGY-RELATED REMOTE AND IN SITU SENSING INSTRUMENT DEVELOPMENT**

*E.V. BROWELL*, U.S. Natl. Aero. & Space Adm., Environ. & Space Sciences Div., *Hampton, Virginia* 23665 (D6-E771-BEU; V625D-68)

OBJECTIVES: To develop advanced and improved instrument techniques for measuring environmental parameters associated with the generation of electrical energy and other pollution sources.

APPROACH: To meet these objectives, the following tasks will be conducted: Task 1 - Raman Lidar - Evaluate Raman Lidar for remote measurement of SO2 concentration at power-plant stack exit. Task 2 -Plume Dispersion Studies: Apply aerosol scattering lidar techniques to the study of plume dispersion under various atmospheric conditions. Task 3 - IR DIAL - To develop and apply the tunable infrared (IR) Differential Absorption Lidar (DIAL) technique to the remote measurement of molecular plume effluents. Task 4 - Laser Heterodyne Detector - To evaluate the use of the laser heterodyne detector technique as a means to increase the sensitivity of long path continuous wave absorption measurements using diffuse reflectors. Task 5 - HCl Monitor - to develop and deliver to EPA an improved in situ HCl chemiluminescent monitor. Task 6 - UV DIAL - To evaluate the UV Differential Absorption Lidar (DIAL) technique for remote measurements of the concentration of SO2, O3, and aerosols at a power-plant stack exit and within the stack plume.

CURRENT PLANS AND/OR PROGRESS: Necessary modifications to the Raman lidar have been completed. A contract has been let for the Tunable IR Laser (delivery January, 1978) which will be integrated with the IR Telescope, detector, and data processor to construct a mobile lidar system. The laser heterodyne detector in the long path laser monitoring system is under evaluation, with a technical report on the effects of speckle scheduled for completion in January, 1978. All laboratory and field evaluation of the HCl detector have been completed. The UV DIAL system will be calibrated and field tested jointly with EPA during January 1978. Operational field tests are scheduled for April, 1978.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Energy Minerals & Industry

**5.0035, REMOTE SENSING OF PORPHYRY COPPER ALTERATION ZONES**

*R.G. SCHMIDT*, U.S. Dept. of The Interior, Geological Survey, *Herndon, Virginia* 22092 (9360-01942)

STATES TO WHICH PROJECT PERTAINS: Arizona.

The project will develop and test techniques of remote sensing of large sulfide deposits, especially porphyry copper type deposits, by digital processing of LANDSAT data. Attempts will be made to relate rock alteration zones, soil minerals, and reflectance characteristics as measured from near-surface with reflectances obtained by scanners in satellites. Methods devised will be tested by using them as evaluation tools in suitable incompletely explored areas that are regarded as favorable for the occurrence of porphyry copper deposits.

SUPPORTED BY U.S. Dept. of the Interior, Geological Survey, Geologic Div.

**5.0036, REMOTE SENSING APPLICATIONS TO LAND RESOURCE INVENTORY**

*B.E. FRAZIER*, Washington State University, School of Agriculture, *Pullman, Washington* 99163 (0070070, WNP00323)

OBJECTIVE: Determine suitability of LANDSAT-based information for land resource inventories. Develop subclasses to the Anderson land use classification that have utility as a data base for local planners. Evaluate other remote sensing systems and techniques for potential application to land resource studies as they become available.

APPROACH: An investigation of LANDSAT-based information products for rural land use applications will be conducted using Whatcom County data. Functional subclasses of the Anderson system will be devised. Photo interpretation and satellite imagery interpretation techniques will be developed to isolate required categories. Evaluate new systems as they become available for public use, i.e., remote sensing instruments, e.g., thermal energy detectors developed for military use.

PROGRESS: Computer programs have been developed to manipulate LANDSAT CCT data. Capabilities are to produce gray scale maps in 10 levels of single or multiple lands, density slices, band ratios or other mathematical combinations, and to

tabulate individual pixed brightness values. Programs have been written to operate at minimum cost by providing for reduced study area sizes (4 mi x 3 mi). Consultation was provided to the Pacific Northwest Regional Commission's Land Resource Inventory Task Force (LRITF) via appointment to its University Advisory Committee (UAC). Accomplishments of the UAC include evaluations of several LRITF remotes sensing projects and submission of mobile analysis lab proposal to NASA and PNRC. Land use change investigation in Whatcom county has continued in order to define specifically the shift from prime to non-prime agricultural areas.

SUPPORTED BY Washington State Government

**5.0037, NAVY ENVIRONMENT - PHYSICAL OCEANOGRAPHY OF THE BARENTS AND KARA SEAS**

*K. AAGAARD*, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (DN123234; N00014-75-C-0893)

ASW and USW operations require knowledge of the physical oceanography and the dynamics of the water masses. The objective of this proposal is to commence an analytical effort of the physical oceanography of the Barents and Kara Seas. The emphasis will be on descriptive hydrography (water masses, spatial and temporal distribution, mixing, etc.), volumetric analysis, seasonal cycles, circulation, exchange with the atmosphere and effect of ice and fresh water on oceanic processes.

A fairly large amount of data is available from a variety of sources, particularly data obtained in the Barents which has been subjected to intensive investigation in recent years by European fisheries research institutes. Therefore an ample data base exists to make a very thorough start on the regional oceanography of the area. The contractor will primarily rely on critical use of ICES and WODC data listings and what is likely obtainable additionally through personal contacts, along with possibly applicable remote sensing data (e.g., satellite IR and ice imagery). There will be no field effort.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**5.0038, GATE DATA ANALYSIS AND RELATED STUDIES**

*R.J. REED*, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (ATM76-06200 A02)

The objectives of this research continue to be the investigation of. (1) the kinematics, dynamics, and thermodynamics of large-scale easterly (or African) waves and their relationship to smaller-scale convective activity. (2) The characteristics of long-period, large-scale fluctuations in the intensity of the Intertropical Convergence Zone (ITCZ). (3) The structure and behavior of meso-scale convective systems and their interaction with larger-scale tropical circulation features.

The observations collected during the Global Atmospheric Research Program (GARP) Atlantic Tropical Experiment (GATE) are being used to carry out these objectives. Collaboration with Gate scientists at other institutions is underway in an effort to utilize the knowledge gained from these investigations to describe the properties of convective cloud ensembles in terms of synoptic-scale variables; an important task for improving weather and climate prediction and simulation.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

**5.0039, LIDAR INVESTIGATIONS OF RAIN**

*J.A. WEINMAN*, Univ. of Wisconsin, School of Letters & Science, *Madison, Wisconsin* 53706 (ATM76-21304 A01)

The objective of this research is to seek additional information on rain by means of monostatic lidar remote measurements over what can be obtained by radar and rain gauges. A lidar system which will be able to measure Raman scattered returns at close range and which will also be able to measure the effective extinction coefficient of rain as a function of receiver field of view will be developed. The combination of these measurements will permit the evaluation of multiple scattering and perhaps provide information on the raindrop size distribution. This lidar system will also display data in range height indicator and plan position indicator formats which will facilitate the investigation of rapidly changing rainfall structure.

The quantitative measurement of rainfall using radar alone is difficult; however, a radar operating in conjunction with a lidar could provide a better measurement of rainfall. The lidar system will be operated with radar and rain gauges for the purposes of quantitative intercomparison.

A theoretical investigation of the scattering of laser pulses from large raindrops will be pursued. The effects of multiply scattered lidar pulses in rain showers will be modeled. The uniqueness of extinction coefficients derived from multiply scattered lidar returns will also be investigated. This is important research in view of the need for better understanding and quantifying rainfall processes with regard to food production and weather modification.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

## LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

**6.0001, INSTRUCTIONAL METHODOLOGIES SAAC**

*J. REED*, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF223820)

To determine the contribution of a variety of instructional techniques on student learning in the SAAC.

For each instructional technique to be researched, a group of students in a control group will be given training devoid of the specific technique. Another group of students will be given the same training using the technique. A comparison of student performance in the aircraft will be made.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

**6.0002, PRE-PROGRAMMED FLIGHT DEMONSTRATIONS IN THE SAAC**

*J.C. REED*, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF223680)

To provide a standardized model of basic fighter maneuvers (BFM) performance in the simulator for air-to-air combat by recording a series of pre-programmed maneuvers covering both standard performance and performance over a wide range of proficiency. This study will provide a library of data for use by AFHRL and other research activities to eliminate a deficiency in available data for research purposes. The demonstration library will be maintained at Luke AFB for use by NASA and DOD activities.

A group of instructor pilots (F-4) will fly the selected maneuvers in the SAAC and will be graded on each trial by a second group of IP's to determine the maximum proficiency data base. The wide range of proficiency measures will be obtained by recording a selection of pilots with a wide range of subject matter expertise. These pilots will be graded as above to select a representative data base. The finalized data tapes will be reviewed for validity towards meeting the stated objectives.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

**6.0003, TACTICAL PERFORMANCE CHARACTERIZATION**

*L.J. FOGEL*, Decision Science Incorporated, *San Diego, California* 92117 (DF228490; F33615-78-C-0011)

To develop advanced techniques for characterizing important aspects of tactical performance in flight simulators for display at the instructor/operator station (IOS). The work will include development and test of methods for quantifying the value of importance assigned by student to various performance criteria and to the acquisition of various vantage points in the maneuvering envelope. This type of information, when displayed at the IOS, will provide valuable training data not otherwise available through conventional displays.

An adaptive maneuvering logic (AML) program has been developed to emulate the opponent in one-on-one tactical combat. The approach is to develop a modification of this program which can compute the subjective weights assigned by a student to various short- and long-term performance goals or tactical objectives. The first phase of the study will be to develop and demonstrate the mechanics of the necessary computations - 9 MAC. The second phase, to be conducted only upon successful completion of the first phase, will include demonstration/refinement of the method using real pilot data recorded on the air combat maneuvering range - 15 MAC.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

**6.0004, DYNAMIC SCHEDULING MODELS FOR MANPOWER AND AVIATION TRAINING**

*W.L. WILKINSON*, George Washington Univ., Program in Logistics, *Washington, District of Columbia* 20006 (DN723675; N00014-75-C-0729)

Increases in the technological complexity and costs of modern weapons systems coupled with emphasis on fleet mobility, endurance, and quick reaction capability present new and difficult challenges to logistics research. The challenge is that of developing models and techniques which afford major improvements in the efficiency and precision of logistics procurement, distribution, maintenance, and transportation policies and practices. Additionally, there is a need to design methodology to permit cost/effective measures of the relationship between logistics support and fleet operational readiness.

Two projects will be undertaken. The first of these will be a study of costs of total contractor logistic support of naval training aircraft. The second will be the development of a technical paper summarizing the applications made of an aircraft utilization simulation. The simulation was developed in 1971 and has been in regular use since then in a variety of studies.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**6.0005, DIETARY HABITS OF PILOTS INVOLVED IN AIRCRAFT ACCIDENTS**

*C.H. HANSON*, U.S. Dept. of Defense, Armed Forces Inst. of Path., *Washington, District of Columbia* 20306

The purposes of this study were to determine the types of diets followed by the crew members during the 72 hours prior to the fatal crash and to determine if the diets were nutritionally adequate.

During the past year, 90 cases were studied; information was manually extracted from the cases in order to assess, on an individual basis, the diets that were followed.

The results of the investigation failed to provide sufficient evidence to support the research on diet. The information gathered from the USAF 711gA (72 hour history) indicated that it was not uncommon for the crew members to have abstained from food for as long as 12 hours prior to aircraft takeoff. Additionally, it was not uncommon for the meals eaten in the final 72 hours to have contained a large quantity of 'junk foods.' The 72 hour histories on the majority of cases studied (which included Army, Navy and Air Force) were filled out insufficiently to provide the necessary data for an overall assessment of diets.

SUPPORTED BY U.S. Dept. of Defense, Armed Forces Inst. of Pathology

**6.0006, DEVELOPMENT OF OPERATIONAL AUDITORY PERFORMANCE STANDARDS FOR NAVY AVIATION PERSONNEL**

*J.D. MOSKO*, U.S. Navy, Acoustical Sciences Division, *Pensacola, Florida* 32512 (DN777307)

The objective of this proposal is to develop a workable set of psychoacoustic standards which reflect the operational requirements for the human auditory system over a broad spectrum of naval aviation tasks.

The program of research to be conducted will be based on the role of the auditory system in relation to the overall task performance. The requirements for the auditory system will be derived from a simple operational model of task performance. Inputs to the model will come from: (1) compilation and analyses of operational tasks; (2) description and analyses of operationally relevant auditory sensory inputs and relevant auditory processing requirements; (3) description and analyses of environmental and psychophysiological factors which influence auditory performance; and (4) laboratory and field experiments with operational personnel to confirm the applicability of the psychoacoustic standards.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Aerospace Medical Research Lab.

**6.0007, DETERMINATION & IDENTIFICATION OF HUMAN BRAIN WAVE PATTERNS ASSOCIATED WITH COGNITIVE & PERFORMANCE EVENTS IN OPERATIONAL SETTINGS**

*E. DONCHIN*, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (DN675068; N00014-76-C-0002)

The overall objective is to attempt to determine and identify human brain wave patterns associated with (1) particular stimuli; (2) cognitive events in a learning situation; (3) performance events in a simulated aircraft cockpit. Such information could provide a basis for improving human performance in decision making and man-machine communication.

Work during the first year will include further development of an event related potential (ERP) vocabulary, i.e., the analysis of cortical potentials into specific components as they relate to cognitive events. At the same time equipment and procedures will be introduced in the 0omputer-assisted instruction laboratory and the human performance laboratory and experiments will be started to test the efficacy of ERP in enhancing performance in the instructional and cockpit environment.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**6.0008, VARIABILITY OF HUMAN PHYSIOLOGICAL RESPONSES TO THERMAL STRESS**

*F.H. ROHLES*, Kansas State University, School of Arts & Sciences, *Manhattan, Kansas* 66506 (DF320440; F33615-77-C-0601)

This effort is to define man's inter-individual variability in physiological responses to heat. The findings will provide USAFSAM scientists with rationale and criteria required to establish realistic design specifications for modern aircraft environmental control systems.

A sample population will be selected that is representative of Air Force flying personnel, male and female, of sufficient number to permit meaningful statistical application of results to the entire population in question. Normal range of selected physiological responses when this population is exposed to rest in various hot-dry and hot-humid environments will be determined. The time course of recovery of these physiological parameters after the removal of thermal stresses will be charted. A technical report will be composed which will include a comprehensive discussion of (a) related literature, and (b) the experimental findings of this study with particular emphasis on the predictability of man's physiological responses to thermal stress.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

**6.0009, EFFECTS OF SLEEP DEPRIVATION ON THE CENTRAL NERVOUS SYSTEM**

*A.K. SINHA*, Coll. of Med. & Dent. of N.J., School of Medicine, *Piscataway, New Jersey* 08854 (DF051050; AF-AFOSR-3532-78)

AF function - Air Force operations expose personnel to a wide range of physiological stresses including prolonged missions with altered work/rest cycles. Varying levels of fatigue and performance degradation may occur as a result of such conditions and thus could impact on the efficiency of aircrewmembers and support personnel. Deficiency - sleep loss and fatigue due to extended missions occur in many Air Force operations. The ability

to reduce crew rest requirements would be a significant application of this research effort. Objective - it is generally accepted that dramatic and incapacitating behavioral changes take place in human subjects due to prolonged sleep deprivation. It is assumed that the behavioral decrement due to sleep loss is a consequence and symptomological expression of cellular and subcellular level changes taking place in the brain cells during the deprivation period. The long-term objective is - to detect and describe some of these changes, to explore the possibility of reversing them (thereby reversing or minimizing the functional decrement) by chemical intervention and, to determine if qualitatively same biochemical changes take place during cyclic alterations between normal sleep and wakefulness. How research contributes - this research will provide essential information on the effects of sleep deprivation on central nervous system integrity. Findings will be applied to the establishment of rest recovery procedures for flight crews/support personnel and will feed in to related on-going in-house 6.2 efforts at USAFSAM.

A variety of stressful situations is known to stimulate neuroprotease (lysosomal) activity. This generalization suggests that neuroprotease activity in brain will increase following sleep deprivation. A number of conditions (exercise, starvation, infection, hypoxia) and chemicals (progesterone, vitamin A, hyperbaric oxygen) are known to cause simultaneous increase in neuroprotease activity and sleeping time. Based on these observations this effort proposes the following working hypothesis. Prolonged wakefulness or sleep loss increases neuroprotease activity, which causes subcellular disorientation in brain cells and is behaviorally manifested in sleepiness and associated behavioral decrement. This hypothesis will be tested by light and electron-microscopic survey of morphological changes in brain cells due to prolong sleep loss.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

**6.0010, PSYCHOPHYSICAL INVESTIGATION FOR COMPLEX TRANSPARENCY SYSTEMS**

*F. WORD*, Systems Research Labs. Inc., *Dayton, Ohio* 45432 (DF323420; F33615-77-C-0535)

Experience in the design and use of windshields for high-performance aircraft has led to a need for establishing practical minimal optical specifications which will assure acceptable and safe pilot performance. Recent developments have demonstrated that previously acceptable optical standards are difficult and extremely costly to meet due to windshield design changes to provide bird impact resistance, to add radar reflective coatings, and to accommodate various aerodynamic profiles. The research objective is to develop a standard, systematic, and reliable visual inspection procedure for assessing optical distortion observed in aircraft windshields. The intention is to relate systematically derived perceptual judgments concerning the effect of distortion to quantitative measurements of windshield distortion. In this way, minimal optical specifications for the limits of distortion which consider its perceptual consequence can be established in a quantitative fashion.

The approach will be to conduct several laboratory experiments which will require subjects to judge the severity of distortion observed in aircraft windshields while viewing selected targets. The effort will involve creating appropriate visual targets, investing the relative value of various psychophysical scaling techniques, and relating perceptual judgments of distortion to various optical measures. The outcome of this effort will be the development of an inspection procedure which can be reliably used in an industrial setting for visually inspecting aircraft windshields for optical distortion.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

**6.0011, WHOLE-BODY EFFECTS OF AIR FORCE NOISE ON PEOPLE**

*C.S. HARRIS*, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF313070)

A wide range of intense Air Force noise environments not only effect hearing but may interfere with motor performance, physiological functioning, thought processes and contribute to fatigue in personnel. This effort investigates types of noises and exposure conditions in which accomplishment of the Air Force mission may be threatened because of these adverse whole-body effects. Results are used to formulate exposure limitations and establish specifications for use by Air Force activities responsible for assuring that personal noise exposures are non-hazardous.

The approach is to measure effects of the many kinds of noises (infrasound, audio frequencies, impulses) on a battery of standard performance tasks on circulation in the peripheral members (fingers) and other physiological processes and on mental tasks such as memory. Findings are used to establish exposure limits beyond which undesirable effects may occur. Much of this work is possible only because of the unique laboratory sound generators available at AMRL.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch. Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

**6.0012, TRANSMISSIBILITY CHARACTERISTICS OF THE PRIMATE SPINAL COLUMN**

*A.R. SLONIM*, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF324110)

To determine the extent and characteristics of transmissibility of motion up the spinal column of the rhesus monkey and baboon. This effort will examine also the nature (e.g., phase change) of the response of the anterior and posterior portions of the spinal column. These data should provide some insight into the transmissibility of vibration in the spinal column of man, with the ultimate objective of developing a model for predicting vibrational effects on both primate and human spinal columns, as well as developing criteria and protective measures for the safety of crewmen in aerospace operations.

Primates will be surgically prepared with implanted accelerometers at different locations on the spinal column and then exposed to vibrations of low frequency (below 100 hz). A series of four experiments will be conducted over a period of one year. The first experiment will evaluate the effect of vibration on rhesus monkeys with two implanted accelerometers, one at an upper thoracic level and the other attached to the sacrum. A second series of experiments will utilize baboons instead of rhesus monkeys. The third group will add a third accelerometer on the baboon at the lower thoracic level. The latter will be on the posterior column, while the upper thoracic accelerometer will be on the anterior column. The first three series will utilize three primates each. The fourth series will utilize up to 7 baboons in which the intervertebral discs have been removed at one or more levels to gain further insight into the mechanics of transmissibility of motion through the spinal column. In all experiments, an attempt will be made to correlate the response resonances observed with various physiological variables and later with resonances predicted from mathematical models of transmissibility.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

**6.0013, AIRCREW PERSONNEL PROTECTION, ESCAPE AND SURVIVAL SYSTEMS**

*D.N. DESIMONE*, U.S. Navy, Crew Systems Department, *Warminster, Pennsylvania* 18974 (DN833230)

To provide naval aircrew personnel with the operational capability to perform aircrew tasks with maximum efficiency; to neutralize the effects of in-flight stresses; and to provide for escape survival and rescue following loss of the aircraft. The following elements support this effort in addition to those listed in item 10 above: P.E. 62241N; P.N. F41-451; P.E. 63216N; P.N. W0583000 and W0584001. P.E. 60000N; P.N. WR68E89, and 510000002, P.E. 63203N; P.N. WSI-08.

The NavAirDevCen will provide the technical management of the full life cycle of aircrew personnel protection escape and survival systems. The management will include the various phases of RDT&E acquisition, production, deployment and ILS. Programs will be reviewed, monitored and funded as needed to maintain a continuing flow of progress and milestone achievement. Work is also being performed on contract as reported in various work units.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

**6.0014, BLOCK PROGRAM BIOMEDICAL TECHNOLOGY PERSONNEL PROTECTION AND SURVIVAL**
*E. HENDLER*, U.S. Navy, Crew Systems Department, *Warminster, Pennsylvania* 18974 (DN681085)

To provide solutions to aircrew personnel problems related to the scope of the subproject, by improving and expanding on the applicable technologies. In meeting the objectives, development may be in response to new requirements, or result from state-of-the-art advances which provide new approaches to problems. Proposed solutions to specific aircrew problems are developed and evaluated for feasibility and practicability. Fulfillment of these objectives may involve development of new techniques and products, or application of existing techniques and products in innovative ways.

Development efforts to meet the primary objectives include the experimental development of or search for new materials, components, techniques of fabrication, subsystems and systems. Efforts will vary from the fundamental to the sophisticated application of the principles of science, engineering, and psychology.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

**6.0015, AIR FORCE VALIDATION OF ASVAB FORMS 6 AND 7**
*J.J. MATHEWS*, U.S. Air Force, Human Resources Laboratory, *San Antonio, Texas* 78235 (DF233130)

To validate operational ASVAB subtests and composites against Air Force technical training performance criteria.

Current ASVAB tests will be correlated with technical training criteria. Some analyses will involve data which has been collected on 9,000 airmen experimentally administered ASVAB-7A. Possible sex and racial interactions in selector composite-based prediction will also be investigated. In instances where feasible, new composites will be formed for appropriate technical courses. Operational ASVAB test data collected at field stations (data will be obtained from mardac tapes) will also be validated, and comparisons will be made between experimentally and operationally administered test results. Milestones -- field tested samples selected - 1 May 77 to 1 Jul 77, operational test analyses - 1 Jul 77 to 1 Nov 77, interim TR preparation - 1 Nov 77 to 1 Mar 78, ASVAB7A samples selected 1 Jun 77 to 1 Sep 77, ASVAB7A analyses - 1 Sep 77 to 1 Feb 78, administration comparison - 1 Mar 78 to 1 Sep 78, final TR preparation -- 1 Oct 78 to 1 Mar 79.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

**6.0016, GLAUCOMA/OCUSERT EVALUATION**
*T.J. TREDICI*, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF323080)

Work unit 7755-16-03, Glaucoma, defines the broad guidelines to be used for identification, follow-up, and treatment of the majority of USAF flying personnel with glaucoma. This work unit deals with those individuals who cannot be treated with the presently recommended drugs (epinephrine derivatives) or who can no longer be controlled by this medication. Pilocarpine is by far the most useful drug available to control the intraocular pressure. Unfortunately, its side effects (myopia and miosis) preclude its use in flying personnel. Pilocarpine in the new delivery system (Ocusert) has recently been developed by Alza Corporation. It is a controlled release wafer that is inserted into the conjunctival sac and changed once weekly. It is reported to have only minimal visual side effects. If so, this would be ideal for flying personnel in need of treatment for glaucoma.

Glaucoma patients being treated with Ocusert at the Ophthalmology Branch, USAFSAM, referred by flight surgeons or the USAF surgeon General's Office, will be closely followed to assure that the drug does not cause a significant decrement to the visual function. These data will be used to formulate new suggestions and regulations for the treatment of glaucoma in flying personnel.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

## MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

**7.0001, THE DYNAMICS OF GRAVITATING SYSTEMS**
*C. HUNTER*, State University of Fla. Sys., School of Arts & Sciences, *Tallahassee, Florida* 32306 (MCS77-28148)

Continuation of MCS-7506177. This research deals with five problem areas concerning the dynamics of galaxies: 1) calculating large scale modes of oscillation of disc galaxies, 2) the stability of galaxies, 3) the underlying structure of galaxies, and the significance of approximate integrals of motion, 4) a re-examination of the bending of otherwise flat galaxies, and 5) the dynamics of the process of fragmentation by which groups of stars may be formed.

SUPPORTED BY U.S. National Science Foundation, Div. of Mathematical & Computer Sciences

**7.0002, DYNAMICS OF GALAXIES**
*C. LIN*, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (MCS78-04888)

Renewal of MCS-7513878.

The investigators will tackle some major unsolved galactic problems, with a new emphasis on related topics in plasma physics. These will include the maintenance of spiral structure, global instabilities of disc-shaped galaxies, barred galaxies and their properties, the evolution of nuclear species in galaxies, nonlinear effects in density waves, and other topics. Partial progress has already been made in some of these areas.

SUPPORTED BY U.S. National Science Foundation, Div. of Mathematical & Computer Sciences

**7.0003, LANDSAT DIGITAL DATA CLASSIFICATION**
*UNKNOWN*, Bendix Corporation, *Ann Arbor, Michigan* (004.2-76; 14-16-0008-2160)

The study will obtain and process LANDSAT digital data by computer to produce vegetation and land-use surface feature classifications according to a classification system to be supplied by FWS on the five Regional Environmental Test Sites. Error analysis and quantitative evaluation will be conducted on classification accuracy, geographic accuracy, and areal measurement precision on all areas classified.

PRODUCTS: 1. A manual explaining the methods, applicability, advantages and disadvantages, and limitations of LANDSAT digital data relative to fish and wildlife habitat evaluations. 2. Computer written, color-coded maps for all the land areas within each Regional Environmental Test Area at a scale of 1:250,000.

SUPPORTED BY U.S. Dept. of the Interior, Fish & Wildlife Service, Office of Biological Services

**7.0004, DISTRIBUTIONAL WEIGHT FUNCTIONS AND ORTHOGONAL POLYNOMIALS**
*A.M. KRALL*, Penn. State University, School of Science, *University Park, Pennsylvania* 16802 (DF050460; AF-AFOSR-3508-78)

AF function - aerospace vehicle design and operation. Opportunity - a new mathematical idea promises to unify and extend the applicability of a technique used in engineering and logistics. Objective - to extend useful theorems in Fourier analysis to functions orthogonal under distributional weight functions.

Fourier analysis is a common tool in fields including statistics, differential equations, and communications theory. Elementary use requires function sets orthogonal with respect to some weight function. Professor Krall has enlarged the usable function sets by including DIRAC delta function derivatives in the weight functions. Examples include Bessel and certain LaGuerre and Hermite polynomials not previously treated as orthogonal.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

## PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

**8.0001, EXPERIMENTAL STUDIES OF ONE-DIMENSIONAL ORGANIC METALS, ONE-DIMENSIONAL INSULATORS, AND NEW SUPERCONDUCTING MATERIALS**
*W.G. CLARK*, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (DMR77-23577)

An experimental research program to study the polymeric superconductor polysulfur-nitride (SN), the superconducting rare earth molybdenum selenides, and several types of pseudo one-dimensional (1D) materials is under way. The superconducting properties of (SN)x are investigated at temperatures as low as 7 millikelvin through measurements of the critical field, critical currents, specific heat, and thermal conductivity. One of the quantities sought is the superconducting energy gap. Chevrel-phase superconductors, such as Gd1.0Mo6Se8, are studied by measurements of specific heat at very low temperatures in external magnetic fields up to 80 kG to test for the coexistence of ordered magnetism and superconductivity in this material. The magnetic properties of the ground and low-lying excited states of several highly conducting, pseudo one-dimensional charge transfer salts will be studied using nuclear magnetic resonance, susceptibility, and specific heat measurements at very low temperatures.

First year of a three-year continuing grant. This is continuation of research supported under DMR 73-07612.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0002, QUANTUM FLUIDS AND SOLIDS**
*A.L. FETTER*, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (DMR75-08516 A01)

A theoretical study will be made of normal and superfluid helium and of electrodynamic effects in layered conductors. Non-uniform textures and ion mobility will be studied in helium-three and the effect of a free surface for ions in superfluid helium-four. Electrodynamic effects in layered conductors will be analyzed with the self-consistent field method, emphasizing the role of tunnelling in static and dynamic screening.

Research previously supported by DMR75-08516.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0003, SUPERCONDUCTIVITY OF MULTICOMPONENT MATERIALS**
*B.T. MATTHIAS*, Univ. of California, Graduate School, *San Diego, California* 92037 (DMR77-08469)

A search for new superconducting materials will be undertaken in order to: 1) increase the maximum superconducting transition temperature, 2) increase the maximum critical field, and 3) increase and general knowledge of the occurrence of superconductivity in intermetallic systems. The effort will involve simultaneously the techniques of physics, chemistry and metallurgy. Synthesis of new multicomponent superconductors will be based in part on old hypotheses such as the electron-per-atom rules in binary systems and in addition search will be made for new rules or hypotheses for more complicated systems. Metallurgical properties such as hardness and ductility will be part of the study. Particular emphasis will be placed on combinations of light elements such as boron, carbon, nitrogen, sulfur, and phosphorus with transition elements forming true ternary phases. Metallurgical properties of previously known superconductors will be improved.

First year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0004, EXPERIMENTAL RESEARCH IN THE PHYSICS OF ELEMENTARY PARTICLES**
*R.A. SWANSON*, Univ. of California, Graduate School, *San Diego, California* 92037 (PHY78-10811)

Support is provided for a research program in experimental elementary particle physics. This group will explore the nature of the forces between hadrons by observing and analyzing the charge exchange processes: 1) negative Kaon p yields KOXO where Xo represents a neutral system of one or more particles, 2) negative Kaon p yields KOn.

This work represents a continuation of that currently supported under Foundation grant PHY76-20415 A01.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

**8.0005, ELECTRON TUNNELING STUDIES OF SOLID SURFACES AND INTERFACES**
*P. HANSMA*, Univ. of California, School of Letters & Science, *Santa Barbara, California* 93106 (DMR76-83423 A01)

Inelastic electron tunneling studies of adsorbed atoms and molecules on surfaces of metals and insulators previously supported by NSF grant DMR-7203276A02 will be continued. Specifically, inelastic electron tunneling spectroscopy will be used: (1) to identify new species, and possibly catalytic intermediates, on both oxides and supported metals, (2) to further develop the use of peak intensities of determining the orientation of surface species, (3) to extend research on electron beam damage in monolayers, (4) to explore reactions between monolayers and evaporated metals, atoms, and finally (5) to continue two fruitful collaborations in elastic and Josephson tunneling.

Experimental investigations of the bonding between carbon monoxide and metals supported on alumina will be continued. The long-term goal in this area is to find new and useful information about an important class of reactions: the synthesis of hydrocarbons from the products of coal gasification on supported metal catalysts.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0006, BASIC RESEARCH IN NUCLEAR PHYSICS**
*J.J. KRAUSHAAR*, Univ. of Colorado, School of Arts & Sciences, *Boulder, Colorado* 80302 (EY-76-C-02-0535.A001)

Although the primary purpose of the effort at the Nuclear Physics Laboratory is basic research, a number of projects have been undertaken that relate at least indirectly to the energy program. (1) Neutron-nucleus scattering cross sections deduced from proton elastic scattering (p,n) isobaric analogue cross sections. The method can provide quite precise neutron cross sections and avoid the difficult and costly neutron elastic scattering measurements of cross sections that are needed for both the fission and fusion reactor programs. (2) Cross sections for boron-burning CTR. These cross sections are of interest because they relate to the buildup of radioactivity in the boron-burning CTR. (3) The 9-Be(p,d)8-Be cross sections at 14.5 MeV were measured at the explicit request of the cross section group of the CTR program. These cross sections were communicated directly to the requesting agency. (4) Thick target activation yields as a tool for temperature and flux diagnostics in plasmas. The group here measuring cross sections for the explosive nucleosynthesis program has developed a very useful procedure for measuring low-energy (p,n) and (p,gamma) reaction cross sections for about 80 targets of astrophysical interest. (5) The energy dispersive x-ray fluorescent method is currently being used for a detailed trace element analysis of oil shale materials. (6) Determination of trace amounts of fluorine by proton inelastic scattering. The element fluorine has been identified as one of the most environmentally significant releases in coal-burning. (7) An intense source of fast neutrons has been made possible by the development of a high-pressure deuterium target and the use of the D-D reaction at 17.5 MeV.

SUPPORTED BY U.S. Dept. of Energy

**8.0007, RESEARCH PROGRAM IN MATERIALS SCIENCES**

*M.H. COHEN*, Univ. of Chicago, School of Physical Sciences, *Chicago, Illinois* 60637 (DMR77-24223)

Partial research support is provided for 19 faculty from the Departments of Physics, Chemistry, and Geophysical Sciences. Major coherent programs are carried out in the following two areas: (1) Disordered Materials - Theoretical and experimental research on the properties of semiconducting glasses, metal-molten salt solutions, disordered metals, and new types of materials preparation are emphasized. (2) Materials at High Pressures and High Temperatures - The emphasis in this program is primarily on systems of geological interest, with some implications for ceramic materials. Complex multicomponent systems are studied using high-pressure and high-temperature techniques with respect to their phase diagrams, thermodynamic properties, crystal structures, and reaction kinetics.

There is also a less formalized junior faculty program which includes studies of critical phenomena, superfluid He3, disordered metals, and dense fluids. In addition support is provided for operation and maintenance of a variety of central facilities, primarily in the two main areas of concentration, and for capital equipment acquisition.

This award is a continuation of DMR76-00697 A02.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0008, ANGLE RESOLVED PHOTOEMISSION STUDIES OF SOLID SURFACES AND OVERLAYERS USING SYNCHROTRON RADIATION**

*Z. HURYCH*, Northern Illinois University, School of Liberal Arts & Sci., *Dekalb, Illinois* 60115 (DMR78-11663)

The experimental research program to study the electronic structure of solids, surfaces and interfaces by means of Ultraviolet Photoemission Spectroscopy (UPS) using synchrotron radiation which previously was supported by NSF grant DMR-7616436 A01 will be continued. The experimental studies will focus on two research areas. The first includes problems related to bulk as well as surface electronic structures of the layered semiconductor Bi2Te3 (both clean and with adsorbate), and calculation of the angular patterns that would ascertain the relative role of single (Bragg) and multiple scattering in the photoemission process. Also surface and bulk properties of selected sodium tungsten bronzes will be studied. The second area, representing a new effort, will be studies of the electronic properties of ordered chalcogen overlayers adsorbed on single crystal surfaces of a series of d-band metals, Ni, Ag and Cu. Here specific advantage will be taken of an active collaborative interaction with the theoretical group of Professor S. Y. Tong (University of Wisconsin at Milwaukee). Comparison of experiments with state-of-the-art theoretical treatment should allow, by means of identification of the symmetries and locations of the bonding sites, determination of the basic properties of the chemisorptive bond.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0009, COMPUTER SIMULATION OF KINETIC PROPERTIES OF PLASMAS**

*J. DENAVIT*, Northwestern University, Technological Institute, *Evanston, Illinois* 60201 (EY-76-S-02-2200)

The proposed research relates to (A) Analysis and computer simulation of trapped-particle modes in Tokamaks. Computations are based on a spectral formulation of the drift kinetic equation in toroidal geometry. Research directed toward gradient and curvature drift effects, application of Fokker-Planck collision model with pitch-angle diffusion, nonliner mode coupling effects and effects associated with finite aspect ratios, radial eigen mode computations. (B) Computer studies of the stability of field-reversed ion rings. Continued development and testing of a linearized 3-D hybrid code with beam ions represented as azimuthally deformed ring-shaped particles and the ambient plasma represented in terms of MHD equations with zero pressure. (C) Application of 1-D particle simulation codes to basic electrostatic wave phenomena.

RESULTS: (1) Computer simulations of dissipative trapped electron modes in Tokamak, confirming main features of the instability, viz., dependence of the growth rates on the gradient ratio eta, square root of the aspect ratio epsilon 1/2 and energy dependence of the collision frequency. (2) Stability studies of field-reversed ion rings using a 3-D linearized particle code with the ambient plasma contributing charge neutralization only.

SUPPORTED BY U.S. Dept. of Energy, Div. of Magnetic Fusion Energy

**8.0010, PLASMA INSTABILITIES**

*M. RAETHER*, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801

Statistical properties of plasma turbulence: A plasma tubulence resulting from an ion acoustic instability in a linear low pressure discharge provides an ideal medium to test ideas on the statistical properties of turbulent states that go beyond the traditional concepts of total wave energy and spectral density. By measuring the one- and two-point probability densities of the electric field fluctuations, information can be obtained about the underlying ensemble and higher-order correlation.

Interactions in a Beam-Plasma System: A search for explosive instabilities that are theoretically predicted gave negative results. There is reason to believe that wave particle interactions dominate the instability before explosive wave-wave interactions can develop. It has been found that the unstable beam plasma mode couples to an ion acoustic wave that is excited by the beam itself and propagates almost perpendicular to the beam direction.

Nonlinear Stabilization of the Beam-Plasma Instability: Experiments are in progress to test the possibility that a linearly unstable electron beam in a plasma is stabilized by a high level of ion acoustic turbulence. The experiments are carried out in a low-pressure discharge in a strong field.

SUPPORTED BY University of Illinois

**8.0011, SUPERCONDUCTIVITY IN METAL-HYDROGEN SYSTEMS**

*C.B. SATTERTHWAITE*, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (DMR77-08463 A01)

This research program is a continuation of the work presently supported under NSF grant No. DMR75-13083. Its primary focus is on superconducting metal hydrides and the effect of hydrogen absorption and superconductivity of other materials. It involves synthesis of thorium and palladium hydrides and deuterides, Nb3SiHx and single-crystalline Nb3Sn. Experimental projects include: (a) the development of a high-precision specific heat apparatus and study of the low-temperature specific heat of PdHx and PdDx; (b) a study of the 50K phase transition in PdH(D)x; and (c) a study of superconducting tunneling in Th4H15. It also includes collaboration research with other groups in: (a) an EXAFS study of PdHx; (b) neutron scattering experiments on Th4H15; and (c) photoelectron emission studies in the UV and soft X-ray region of thorium hydrides.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0012, ELECTRON TRANSPORT AND MAGNETIC INTERACTIONS IN METALS**

*J. BASS*, Michigan State University, School of Arts & Letters, *East Lansing, Michigan* 48824 (DMR77-04680 A01)

Experimental studies of low-temperature transport properties previously supported by DMR7514138 will be continued. Magnetothermoelectric measurements on simple metals at low and ultra-low temperatures will be done in order to achieve a better understanding of many-body effects in thermoelectricity (i.e., electron-phonon mass enhancement and the Nielsen-Taylor effects) and of the source of the Giant Magnetothermopower Oscillations which were discovered in aluminum and indium in recent research done in this project. Also, the sources and properties of the recently discovered low- and ultra-low-temperature thermoelectric anomalies in tungsten will be investigated. Finally the studies of dilute magnetic alloys using the technique of combining traditional transport and magnetic measurements with

direct and independent determinations of the microscopic spatial distribution of impurities will be continued.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0013, DESIGN, CONSTRUCTION, AND TESTING OF A SUPERCONDUCTING CYCLOTRON FOR HEAVY-ION RESEARCH**

*H.G. BLOSSER*, Michigan State University, School of Natural Sciences, *East Lansing, Michigan* 48824 (PHY76-83254 A02)

This work is the logical continuation of the work in progress under NSF grant PHY75-01080 A02 consisting of the design and construction of a superconducting magnet with an azimuthally varying field and very high field strength. The high field (5 Tesla) will be accomplished by using superconducting wire in the coils. The object of the project is to produce a high-field magnet of sufficiently high quality to serve as the main magnet of an isochronous cyclotron. The magnet was designed to be full scale, allowing it to serve as the basis for a complete cyclotron if the specifications were met.

This grant will extend the feasibility study to the design and construction of the necessary subsystems (RF acceleration voltage, ion source extraction system, etc.) to make a functioning cyclotron. Sufficient auxiliary equipment will be provided to allow for extensive studies of the use of beams provided by the accelerator as nuclear probes.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

**8.0014, MAGNETIC INVESTIGATION OF SOME NEW QUASI-TWO-DIMENSIONAL MAGNETIC SYSTEMS**

*J.E. DRUMHELLER*, Montana State University, School of Letters & Sciences, *Bozeman, Montana* 59715 (DMR76-82089 A01)

The magnetic properties of several quasi-two-dimensional compounds with the basic K2NiF4 structure will be studied. Three methods will be used: electron paramagnetic resonance (EPR), magnetic susceptibility and magnetic specific heat, in order to study the origin of the anisotropy and to measure the ratio of isotopic to anisotropic exchange. The EPR experiments will be used to measure g-tensors, to determine the phonon modulation of the symmetric exchange integral, to measure the anomalous line-width versus angle behavior in spin diffusion and to establish the ratio of interchain to intrachain coupling in linear magnetic systems. Magnetic susceptibility measurements can be used to determine the nature of the interchain and intrachain exchange and the anisotropy of the magnetic spin systems. Specific heat measurements will be used to determine spin-flop behavior in antiferromagnets and to determine the next nearest and the next-next nearest neighbor exchange effects.

This is a continuation of research supported under DMR75-01296. This is the first year of a two-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0015, STRONG INTERACTIONS WITHIN THE FRAMEWORK OF THE TOPOLOGICAL EXPANSION**

*C.E. JONES*, Univ. of Nebraska, School of Arts & Sciences, *Lincoln, Nebraska* 68508 (PHY78-09619)

Research will be done in theoretical physics to further our understanding of the elementary particles. The research program will study the properties of the strong interactions and their relation to a fundamental quark structure. The basis for this study will be the so-called Topological Expansion (TE) of scattering amplitudes. Such an expansion gives successive approximations to unitarity depicted as diagrams with increasingly complex topologies. The first approximation in the TE is the planar amplitude, in terms of which all the higher topological contributions are constructed. Within the context of this technique, several specific projects will be carried out.

This work is a continuation of that currently supported under NSF grant PHY-7614438 A01.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

**8.0016, THEORY OF ELECTRON-PHONON SCATTERING EFFECTS IN METALS**

*W.E. LAWRENCE*, Dartmouth College, School of Arts & Sciences, *Hanover, New Hampshire* 03755 (EY-76-S-02-2315)

Studies of quasiparticle lifetimes and transport relaxation times will be continued for the noble and polyvalent metals. A method for accurate calculation of the transport times at low temperatures will be developed, and applied in specific instances. The variational method will be applied to a number of non-equilibrium phenomena in superconductors. An attempt to clarify the relationships between superconducting and normal-phase lifetimes will be made. Electron-electron scattering will be studied further, with attempt to account for relaxation time anisotropy and the resulting interference with other scattering mechanisms.

RESULTS: Diffusion model derived and formalized; electrical and thermal DMR calculated in detail for potassium and copper, variational convergence tested; quasiparticle properties calculated for aluminium, method developed for low temperature lifetime calculations; superconducting order parameter relaxation times related to anisotropic quasiparticle lifetime of normal phase, detailed calculation done for aluminium; electron-electron effects calculated for noble metals, reviewed for simple metals.

SUPPORTED BY U.S. Dept. of Energy, Div. of Basic Energy Sciences

**8.0017, ULTRAHIGH FREQUENCY ABSORPTION AND NONLINEAR KAPITZA CONDUCTANCE MEASUREMENTS**

*J.H. CONSTABLE*, State University of New York, School of Arts & Sciences, *Binghamton, New York* 13901 (DMR76-11114 A01)

This is a continuation of work begun under DMR76-11114. The resonant absorption of orthohydrogen (oH2) and paradeuterium (pD2) impurities in parahydrogen (pH2), HD and orthodeuterium (oD2) host crystals will be measured in the ultrahigh frequency range and the absorption related to various anisotropic interactions such as the crystalline field. The importance of phonon attenuation and frequency conversion in the energy transport across a crystalline boundary will be assessed by studies of such effects near the boundaries of dielectric crystals.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0018, ULTRAFAST PHENOMENA IN SOLID-STATE PHYSICS**

*R.R. ALFANO*, City University of New York, School of Liberal Arts & Sci., *New York, New York* 10031 (DMR77-27538)

Experimental studies of ultrafast phenomena in solids, glasses and liquids previously supported by DMR-7302392 will be continued. Picosecond laser spectroscopy will be used to investigate the vibrational kinetics and relaxation processes in organic glasses over a temperature range extending into the liquid state. The purpose of this research is to provide insight into the mechanisms responsible for molecular relaxation in solids and liquids.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0019, TOPOLOGICAL PHYSICS**

*D. FINKELSTEIN*, Yeshiva University, School of Science, *New York, New York* 10033 (PHY78-09661)

Research will be done in theoretical physics concerned with the fundamentals of quantum mechanics, and with novel approaches to basic questions. The work will use topological methods in both basic and applied physics. The basic work concerns a conceptual advance in the foundations of quantum physics, a way of constructing physical theories, including their quantization rules, from algebraic topological models like networks, by applying to physical logic the familiar principle that 'only invariants are observable.' This has significance also for computers and neuropsychology. The applied work concerns the consequences of the existence of homotopic charges (kinks) in inviscid hydrodynamics and non-resistive hydromagnetics for the physics of plasma and hydraulic systems, such as Tokamaks and pumps.

This work is a continuation of that currently supported under NSF grant PHY76-04872 A01.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

**8.0020, PROPERTIES OF THE QUANTUM SOLIDS H2 AND D2**

*H. MEYER*, Duke University, School of Arts & Sciences, *Durham, North Carolina* 27706 (DMR78-05378)

This is a continuation of work begun under DMR75-23681.

An investigation will be made of the orientational order-disorder transition in both solid H2 and D2 for which the concentration of the species with rotational angular momentum J equals 1 is less than 0.55. A nuclear magnetic resonance study will be made of the (J equals 1) pair spectrum and of the crystalline field splitting of dilute (J equals 1) H2 in solid (J equals 0) H2 and a similar study in D2. A systematic study of diffusion in solid H2 and D2 under pressure will be made.

This is the first year of a 3-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0021, ISOSPIN AND GIANT-RESONANCE EFFECTS IN NEUTRON SCATTERING AND NEUTRON-INDUCED CHARGED-PARTICLE REACTIONS**

*J. RAPAPORT*, Ohio University, School of Arts & Sciences, *Athens, Ohio* 45701 (PHY78-09911)

This grant will support a program of basic research in nuclear physics. An 11-MeV high intensity pulsed Tandem Van de Graaff accelerator produces mono-energetic neutrons which are being used to carry out studies of neutron-nucleus interactions. Studies of isospin and giant-resonance effects in neutron scattering will be carried out. An entirely new technique to study neutron-induced charged-particle reactions with previously unavailable and flexibility will be further developed.

Giant resonance effects will be studied using high-energy neutrons as probes. Studies of inelastic scattering from several targets will be done in order to see directly these giant states, or as in the case of Carbon-12, to answer other basic questions such as isospin mixing. Measurement of the excitation functions of excited states in isospin equals 0 nuclei will be carried out with high energy neutrons to study the influence of these giant states on the scattering to lower states.

A new facility capable of a broad range of neutron induced charged-particle reaction studies will be developed. Important questions of basic physics as well as important applications will also be pursued.

This is a continuation of work supported under NSF grant PHY76-11450 A01.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

**8.0022, ELECTRONIC PROPERTIES OF LIQUID SEMICONDUCTORS**

*M. CUTLER*, Oregon State Higher Educ. Sys., School of Science, *Corvallis, Oregon* 97331 (DMR77-19035)

Molten binary alloy systems which are liquid semiconductors will be investigated as a function of temperature and composition by means of measurements of the electrical conductivity, thermopower, magnetic susceptibility, and nuclear magnetic resonance. These results will be analyzed in terms of existing or newly developed concepts and theories for the electronic behavior of liquid semiconductors. Emphasis will be placed on problems of broad importance, which include: (1) The study of dangling bonds, and the electrical and magnetic effects of the transition of dangling bond acceptor states from localized levels in the band gap to virtual states in the valence band. (2) The development of bonding models and theories for key alloy systems such as Te-Se, In-Te, and Tl-Se. (3) Critical examination of the interpretation of experimental measurements in domains where existing theory has not yet received adequate experimental support or where discrepancies exist, such as transport in the domain of low electrical conductivities, and the behavior of the nuclear magnetic relaxation rate enhancement factor of tellurium nuclei.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0023, NONEQUILIBRIUM SUPERCONDUCTIVITY AND INELASTIC ELECTRON TUNNELING SPECTROSCOPY**

*D.N. LANGENBERG*, Univ. of Pennsylvania, School of Arts & Sciences, *Philadelphia, Pennsylvania* 19104 (DMR77-27934)

Research will be continued on nonequilibrium phenomena in superconductors. Emphasis will be placed on the determination of the distribution in energy of excited quasiparticles in a nonequilibrium superconductor for several different materials and types of excitation and on the investigation of instabilities in nonequilibrium superconducting states. Several aspects of the behavior of molecules chemisorbed on oxide surfaces will be probed by means of inelastic electron tunneling spectroscopy in superconduction tunnel junctions. This is a continuation of work previously funded under DMR73-02484.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0024, MAGNETIC INTERACTIONS IN SALTS OF THE TRANSITION METALS**

*S.A. FRIEDBERG*, Carnegie Mellon University, Mellon Institute of Science, *Pittsburgh, Pennsylvania* 15213 (DMR78-08651)

Professor Friedberg is continuing and extending a series of investigations at low temperatures of magnetic interactions in transition metal salts belonging in several categories. These include compounds in which (1) single ions or exchange-coupled clusters of ions with singlet ground states interact with energies smaller than the separation of that ground state from a magnetic excited state; (2) dominant spin interactions occur in one or two dimensions; (3) spins order in three-dimensional arrays; and (4) coupled spins occur in isolated clusters. Heat capacities, magnetocaloric effect, magnetic susceptibility, magnetization, magnetic resonance, and neutron scattering are being measured above approximately 30 mk in fields as large as approximately 120 KOe. The problems under study include field-induced electronic ordering and electron-nuclear effects in singlet ground state systems; tricritical behavior in metamagnets; anomalous field-dependence of TN and bicritical behavior in systems with predominantly low-dimensional spin coupling; and, identification of novel low-dimensional magnetic systems.

This is a continuation of work supported under DMR 75-13908. This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0025, TRANSIENT NUCLEAR MAGNETIC RESONANCE STUDY OF SOLIDS**

*I.J. LOWE*, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (DMR78-15441)

Several solid-state physics experiments will be carried out using nuclear magnetic resonance (NMR). These include: (1) a continuation of the measurements of hydrogen diffusion in solids; (2) a continuation of line shape measurements in motionally narrowed solids such as NH4Cl and ice to better understand diffusive motion in solids; (3) a study of superionic conductors such as PbF2 to understand how the motion of the fluorine atoms is influenced by dopants. Measurements of various high pressure phases of ice will also be carried out.

This research was previously supported DMR-7622655.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0026, MATERIAL SUPPORT TECHNOLOGY - OPTICALLY INDUCED HOT ELECTRON EFFECTS IN SEMICONDUCTORS**

*A.L. SMIRL*, North Texas State University, School of Arts & Sciences, *Denton, Texas* 76203 (DN775009; N00014-76-C-1077)

To investigate transient and non-equilibrium effects that affect laser interactions with semiconductor material that finds application in naval electronic systems.

The contractor will investigate the interaction of ultra-short laser pulses with semiconductor material to ascertain the non-equilibrium and relaxation properties of carriers in these materials. In addition, the role of stress and electric field biasing of the absorption properties of semiconductors under illumination by these intense, ultra-short pulses will be investigated. The initial materials to be studied are GaAs and InP.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**8.0027, COLLISIONS INVOLVING ATOMS IN HIGH RYDBERG STATES**
*R.F. STEBBINGS*, Rice University, Graduate School, *Houston, Texas* 77001 (PHY76-11453 A01)

This project is an investigation of the properties of atoms in high Rydberg states. Tunable lasers are used to excite xenon atoms to a single well-defined highly excited state with principal quantum number n in the range 25 is less than or equal to n is less than or equal to 41. The lifetimes of xenon atoms in these states have been determined together with their response to external electric fields. The collisional ionization of xenon atoms has also been investigated in thermal encounters with various molecules. The major thrust of the present proposal is the extension of the scope of these measurements to other species such as Ne, Ar, Kr, and the extension of the scope of the measurements for a given species.

This work is a continuation of that currently supported by Foundation grant MPS74-11690A02.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

**8.0028, SURVEILLANCE - PROPERTIES OF MATERIALS FOR SUPERCONDUCTING SENSORS**
*B. DEAVER*, Univ. of Virginia, School of Arts & Sciences, *Charlottesville, Virginia* 22903 (DN923065; N00014-75-C-0854)

The objective of this task is to study the electronic and magnetic properties of superconducting materials for use in surveillance sensors. New superconducting circuits capable of detecting minute magnetic field changes are being investigated.

This task comprises a variety of experimental investigations in the field of cryogenics. These include: studies of the electrical resistance and magnetoresistance of ferromagnetic metals at temperatures down to 0.3 degrees K.; electron tunneling experiments on ferromagnetic metallic and magnetic oxide junctions; magnetic flux measurements on superconducting rings and thin films; the properties of liquid helium and development of a three-dimensional magnetic wind tunnel balance system using superconducting magnets.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

**8.0029, HIGH-TEMPERATURE PLASMAS**
*E. HYMAN*, Science Applications Inc., *McLean, Virginia* 22101 (DN780194; N00173-77-C-0066)

To model a variety of high-temperature plasmas including the Tokamak, relativistic electron and ion beams, the reflex triode and tetrode, pinched beam diodes, and to calculate dielectronic recombination rates.

The development of computer models to simulate the various plasmas and comparison of model predictions with experimental measurements.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

**8.0030, PROMPT GAMMA RAYS FROM PION REACTIONS ON NUCLEI**
*H.O. FUNSTEN*, Coll. of William & Mary, School of Arts & Sciences, *Williamsburg, Virginia* 23185 (PHY76-14878 A01)

Continued work is planned on experimental nuclear physics studies with positive and negative pions at the Space Radiation Effects Laboratory (SREL) Synchrocyclotron and at the Columbia University Nevis Synchrocyclotron. This work will extend current experiments at the Space Radiation Effects Laboratory in which prompt nuclear gamma rays associated with pion-nucleus reactions are observed with a Ge(Li) gamma-ray detector.

This work will be along two lines, 1) measurements of gamma rays from bound nuclear levels populated by 200 MeV positive pion inelastic scattering to see if the reaction excites predominantly a neutron or proton configuration; 2) search for excitation of analogue levels populated by (positive pion, neutral pion) reactions. Higher pion fluxes expected at Nevis will additionally permit use of scattered pion hodoscope counters for 1) and lead glass neutral pion yields 2 gamma detectors for 2).

This is work is a continuation of that currently supported by Foundation grant PHY76-15878.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

**8.0031, TOPIC IN THE THEORY OF TRANSITION-METAL SURFACES AND APERIODIC MATERIALS**
*J.J. REHR*, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (DMR76-82112)

Three theoretical research projects will be carried out: 1) A new technique for calculating electronic structure in non-periodic solids will be developed. Applications will include calculations of the surface d-electron density in the noble and transition metals and semi-self-consistent calculations of the density of states in transition metal oxides. 2) Analytical studies will be carried out aimed at answering two fundamental questions concerning surface electronic structure: a) How quickly does the electron charge density reduce to its bulk behavior away from a surface? and b) What is the Van Hove singularity structure in the surface densities of states? 3) The third part deals with the theory of extended X-ray absorption fine structure (EXAFS), a new experimental technique for determining local structure in non-periodic materials. Many-body corrections will be studied and calculated. This study should improve experimental determinations of coordination numbers using EXAFS.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

**8.0032, BAND STRUCTURE OF SOLIDS AND OF POINT DEFECTS IN CRYSTALS BY THE LCAO METHOD**
*C.C. LIN*, Univ. of Wisconsin, School of Letters & Science, *Madison, Wisconsin* 53706 (DMR76-83684 A01)

This is a continuation of research supported under DMR-74-06345.

The method of linear combination of atomic orbitals has been demonstrated to be a useful and versatile tool for the accurate calculation of the energy band structures of perfect crystals. This research program will extend this method to the case of imperfect solids. Recently this method has been used to calculate the electronic structure of point defects in crystals, amorphous silicon and adsorptive solid surfaces with successful results. Theoretical studies of the electronic structure of solids will be continued by this research group. The specific topics of research to be covered include (1) impurity atoms and associated defect centers in ionic crystals, and (2) chemisorption of atoms on the Si (111) surface.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

## SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

**10.0001, ASTRONOMICAL POLARIZATION**
*A.M. GEHRELS*, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (AST77-21840)

This research will be devoted to a study of the polarization properties of planets, stars and nebulae. Topics to be studied include the polarization produced by interstellar dust grains, measurements of magnetic fields in dark interstellar clouds, and narrow-band and high resolution spectropolarimetry in the atomic lines and molecular bands. These lines are formed in the extended atmospheres and shells about various types of stars. There will be a search for periodic optical polarization in the binary X-ray pulsars, measurements of stellar magnetic fields, and a determination of the wavelength dependence of polarization in galaxies with active nuclei, Seyfert galaxies, and other energetic extragalactic objects.

In the area of solar system studies, there will be a polarization studies of Venus and Saturn. A new photometer for nearly-simultaneous work at a number of wavelengths will be built.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0002, CLOSE BINARY STARS**

*M. PLAVEC*, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (AST77-22672)

The program constitutes a systematic investigation of large classes of close binary stars. New objects and phenomena discovered confirm the significant role of binary stars in stellar astrophysics. A continued study of binary stars in early stages of their evolution is planned to include four important types of close binary stars: 1. Algols. Continue calculations of second-generation evolutionary models under more realistic, non-conservative conditions, including the evolution of the mass-accreting star and to obtain new masses and absolute dimensions for comparison with models. 2. BE Stars and shell stars. Develop the hypothesis that some objects are interacting binary systems. The transition from long-period Algols to shell stars and Be stars will be studied observationally. 3. Detached systems. Complete spectrographic work, to obtain basic stellar parameters for comparison with models of main-sequence and evolved single stars, and for starting points for the evolution of close binaries. 4. Systems with H and K emission. Spectrographic observations will be continued to derive reliable masses and absolute dimensions, and analysis of photometric data concluded. The results will test the hypothesis that these stars are post-main sequence systems losing mass through enhanced stellar wind.

Prior support was by NSF grant AST 74-04194.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0003, THEORETICAL ASTROPHYSICS**

*R.D. BLANDFORD*, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (AST78-05484)

Theoretical and interpretative studies in topics of current astronomical interest will be carried out. Research that relates to radio astronomical observations will be emphasized. Specific areas that will be investigated include: (1) Models of superluminally expanding compact radio sources involving the propagation of shock waves; (2) Black-hole models of quasars; (3) Radio emission from Jupiter's magnetosphere; (4) Statistics of pulsars.

This is a continuation of research previously supported by grant AST 76-20375.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0004, STUDIES IN STELLAR ASTRONOMY**

*J. GREENSTEIN*, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (AST77-09191)

The properties of intrinsically faint stars have been under study by the principal investigator for many years. A large amount of observational material is already available as a result of observing programs carried out on the 200-inch Hale reflector on Mt. Palomar. Statistical and astrophysical studies of these observations will be made in order to determine the spatial distribution and kinematics of these stars in our Galaxy and the solar neighborhood. Physical characteristics, such as temperatures and composition differences, will also be determined. This program will provide new data on low-mass stars which will be of use in studies of stellar and galactic evolution.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0005, GRAVIMETER-GRAVITY EXPERIMENTS - TELESCOPE DEVELOPMENT**

*J. FALLER*, U.S. Dept. of Commerce, Natl. Bureau of Standards, *Boulder, Colorado* 80302 (2741271)

PROJECT OBJECTIVE: Advance state of the art using precision measurement techniques. A) Provide new geophysical tool. B) Develop new techniques for high precision and null-type gravity experiments. C) Develop new type of low-cost telescope.

PROJECT APPROACH: A) Construct and evaluate transportable absolute gravimeter accurate to parts in ten to the ninth. B) Apply newly developed techniques to 'EOTVOS' experiment. C) Bring into operation new type of multi-lensed large-aperture telescope.

PRIOR YEAR ACCOMPLISHMENTS: First range data received with telescope. Five minute period - 22 KM equivalent length - achieved using super spring.

SUPPORTED BY U.S. Dept. of Commerce, National Bureau of Standards

**10.0006, COMMITTEE ON RADIO FREQUENCIES - SUPPORT OF COMMITTEE OPERATIONS**

*R.Y. DOW*, Natl. Acad. of Sciences, *Washington, District of Columbia* 20037 (AST63-00007 A22; C310-023-A22)

The Committee on Radio Frequencies (CORF) of the National Academy of Sciences and Engineering provides timely and authoritative advice and recommendations to the National Science Foundation and other Government agencies in the use of the radio spectrum for research purposes. The CORF has two subcommittees which deal with the areas of spectrum usage in which the Foundation has a direct interest, namely, radio astronomy and space sciences.

At present the Committee is preparing papers documenting the spectrum needs of U.S. research users of the radio spectrum for the next 20 years. These views will be presented via the appropriate Federal channels for input to the U.S. position at the 1979 World Administrative Radio Conference (WARC).

The Committee works via correspondence and periodic meetings of the main and subcommittees. The Executive Secretary at the National Academy of Science is the local contact and handles administrative matters for the Committee.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0007, THEORETICAL STUDIES OF INTERSTELLAR GAS DYNAMICS AND STAR FORMATION IN THE PRESENCE OF MAGNETIC FIELDS**

*T. MOUSCHOVIAS*, Univ. of Illinois, Graduate School, *Urbana, Illinois* 61801 (AST77-23568)

Theoretical studies of the role of the interstellar magnetic field in a variety of phenomena to investigate dynamical processes in the interstellar medium relating to star formation through contraction and fragmentation of interstellar clouds will be carried out. It is generally recognized that the interstellar magnetic field, the energy density of which is comparable with any other interstellar energy density, must play a role in the dynamics of cloud formation, equilibrium and collapse. Yet, mathematical difficulties have prevented the formulation and solution of self-consistent problems relating to star formation that include the effects of magnetic fields in any but the linear regime. Recent advances, the results of which agree with observations, suggest new promising approaches to old outstanding problems in the context of a theory of star formation. Observational and theoretical evidence points to the importance of magnetic fields in star formation and, in fact, to all large-scale interstellar gas dynamics. A new understanding of the process of star formation will be possible when the theoretical research has been completed.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0008, INTERSTELLAR REDDENING IN THE SOLAR NEIGHBORHOOD**

*C.L. PERRY*, Louisiana State Univ. Systems, School of Chemistry & Physics, *Baton Rouge, Louisiana* 70803 (AST77-04056)

The mapping of the dust component of the interstellar medium using observations of stars in the solar neighborhood will be carried out. A network of approximately 3,600 stars has been established with the intent that the stars act as probes in space for the detection of individual dust clouds. The use of uvby beta photometry in conjunction with empirical calibrations will yield precise color excesses and absolute magnitudes.

The data collection process will be completed and the analysis will then be done. This study should then yield answers for such questions as: 1) The relative importance of reddening by discrete clouds versus a diffuse intercloud medium, 2) The space density of such clouds, 3) The linear sizes of the clouds, 4) The approximate distances of the clouds, and 5) Estimates of their masses.

Furthermore, it is anticipated that this investigation will be the basis of other programs such as a polarization of study of the galactic magnetic field in the solar vicinity.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0009, STUDIES OF THE OPTICAL COUNTERPARTS OF X-RAY SOURCES, QUASI-STELLAR OBJECTS, AND RELATED SOURCES**

*W. LILLER*, Harvard University, School of Arts & Sciences, *Cambridge, Massachusetts* 02138 (AST76-00527 A01)

Research on quasi-stellar objects, optical counterparts of x-ray sources, and related objects will be carried out. Modern data obtained with telescopes in the United States and Chile will be combined with historical data taken from the archival plate collection at Harvard College Observatory. The data will be used to derive light curves, search for unidentified counterparts, analyze spectra, monitor spectral changes, and study other peculiarities of the quasars and other sources.

This action provides additional funding and extends the duration of the grant AST 76-00527 A01.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0010, VARIABLE STARS**

*D. HOFFLEIT*, Maria Mitchell Observatory, *Nantucket, Massachusetts* 02554 (AST78-07405)

The Maria Mitchell Observatory is well-equipped for photographic analyses of variable stars in selected fields in the constellations of Sagittarius, Cygnus, Scutum and Coma Berenices. The photographic plate collection of the Maria Mitchell Observatory now exceeds 5600 plates which span a time period of more than 50 years.

Past work has included the discovery of new variable stars, determination of types of light variation, periods, and changes of period. At the present time work will be directed towards two broad classes of stars: those whose periods are changing; and stars showing unusual, peculiar spectra.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0011, STUDIES OF PECULIAR STELLAR SPECTRA**

*A.P. COWLEY*, Univ. of Michigan, School of Lit. Sci. & The Arts, *Ann Arbor, Michigan* 48104 (AST75-20351 A02)

This research will be directed towards: 1. an investigation of the various stages of stellar evolution and 2. the study of the interactions of close companion stars and their effects on the evolution of the stellar system. The observational data will be obtained primarily at the National Observatories (Kitt Peak in Tucson and Cerro Tololo in Chile) and at the Dominion Astrophysical Observatory in Canada.

Special emphasis will be given to the investigation of stellar systems which are strong X-ray emitters. These systems are believed to be in a very late phase of their evolution with one of the components usually a neutron star or highly condensed object. The spectroscopic investigation of these systems will aid in the determination of the physical properties (mass, radius, composition) of highly evolved stars. Effects of mass exchange and transfer between the component stars will be studied. There will be studies on binary systems which do not emit strong X-rays. A comparison of these different types of systems will help in our understanding of stellar evolution.

This is a continuation of research previously supported by NSF Grant AST75-20351 A01.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0012, ASTROPHYSICAL FLUID DYNAMIC STUDIES**

*R.F. STEIN*, Michigan State University, School of Natural Sciences, *East Lansing, Michigan* 48824 (AST76-22479 A01)

Techniques for solving coupled radiative transfer-nonlinear fluid flow problems in one dimension and nonlinear fluid flow problems in two and three dimensions will be developed and used to study interrelated solar problems: 1) The generation of acoustic and magnetic waves by nonlinear interaction with turbulent motions and by overstability due to interaction with the radiative flux. 2) The deposition of energy and momentum in the chromosphere and corona. The goal is to develop tools for analyzing observed solar waves and models of the energy balance in the chromosphere and corona with heating by magnetic, acoustic, and gravity waves. Once a self-consistent solar model is constructed, the same techniques will be applied to other stars where chromospheres and coronas are observed.

Also, accretion onto protostars and the formation of compact H II regions in the dense circumstellar cloud will be studied through the calculation of theoretical models of the evolution of compact H II regions to use with infrared and radio observations to analyze conditions of star formation.

Prior support was by NSF grant AST 76-22479.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0013, HYDRODYNAMICAL INVESTIGATIONS OF GAS FLOW IN THE CENTRAL REGIONS OF SPIRAL GALAXIES**

*R.H. SANDERS*, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (AST76-16713)

Theoretical investigations of the nature of gas kinematics in the central regions of spiral galaxies will be carried out. The purpose of this research is to assess the relative importance of explosive vs. non-explosive origins for non-circular motions in the central regions of normal spiral glaxies. This problem is related to the question of the generality of explosive phenomenon in galactic nuclei, i.e., is explosive release of energy a normal consequence of the evolution of galactic nuclei? This research centers on numerical hydrodynamical calculations of gas response both to point explosions in gaseous disks (explosive hypothesis) and to weakly non-axisymmetric gravitational fields (non-explosive hypothesis). The machine codes for carrying out these hydronumerical calculations have been written and tested on a number of problems. These codes will be used to generate grids of realistic physical models for detailed comparison with observations of gas kinematics in both external spiral galaxies and our Galactic Center region. In particular, comparison of theoretical models with observations of the Galactic center will make use of high resolution carbon monoxide and neutral hydrogen surveys.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0014, EXTRAGALACTIC AND SOLAR SYSTEM RADIO ASTRONOMY**

*J.N. DOUGLAS*, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (AST77-28477)

A program of extragalactic radio astronomy will be carried out in three main phases: 1. Continuation of the Texas Sky Survey. Accurate (plus or minus 1') positions, flux density structure and variability data are being obtained at 380 and 335 mHz for all sources north of minus 35 degrees declination and brighter than 0.25 Jansky (about 50,000 sources). Basic observations will be 95

per cent complete and one-third of the data will have been reduced to publishable form by the spring of 1979. 2. Identification of radio sources from the survey with optical objects from the National Geographical Society - Palomar Sky Survey, using our accurate radio positions and accurate optical positions measured with our computer-interactive laser measuring engine. Experience to date shows about 45 per cent of radio sources to have optical counterparts within 5', having an identification reliability higher than 90 per cent. The entire survey is thus expected to produce about 22,000 optical identifications, an order-of-magnitude increase over what is now available in the literature. 3. Spectroscopic and photometric observations of selected large samples of the identifications are carried out at McDonald Observatory by Drs. Derek and Beverly Wills.

Supplementary programs in instrumentation and synoptic monitoring of Jupiter will also be carried out. This is a continuation of research done under AST 76-01883 A01.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0015, THE DYNAMICAL STABILITY OF THE SOLAR SYSTEM**

*P.E. NACOZY*, Univ. of Texas, School of Engineering, *Austin, Texas* 78712 (AST75-07789)

An attempt will be made to determine if the stability of the planetary system is stronger as the system approaches exact commensurability among the component planets. Preliminary analysis of periodic orbits in a general three-body system, like the Sun, Jupiter and Saturn, indicates that the hypothesis may be correct. If so, it offers one explanation for several present low-order, nearly exact commensurabilities among the major planets and several of the satellite systems.

The solar system stability, in the sense that solution of the equation of motion is obtainable in the form of quasi-periodic functions of the time, will be explored. Solutions will be found for very small planetary mass values for which quasi-periodic motion is present. The mass values will then be increased until the solutions no longer have quasi-periodic motion. The transition away from quasi-periodic motion is expected to be abrupt as the masses are increased. If the actual planetary masses are significantly less than the masses at the transition, it would indicate stability for the planetary system in the sense which is being explored. If the actual masses prove to be close to or larger than the transition mass, the stability of the system would be considered doubtful.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

**10.0016, ASTROMETRIC STUDIES OF NEARBY STARS FROM THE SOUTHERN HEMISPHERE**

*P.A. IANNA*, Univ. of Virginia, Leander Mccormick Observatory, *Charlottesville, Virginia* 22903 (INT77-21525)

Under this new award, work will continue for two years on a cooperative program begun in January, 1976, with the Australian National University's Mount Stromlo and Siding Spring Observatory for the determination of the trigonometric parallaxes and proper motions of nearby, astrophysically important stars in the southern hemisphere. Since the inception of the program, a total of 984 photographic plates of 71 star fields have been obtained. In the coming year, approximately 100 stars will be added to the program, including 15 bright, late-type giants to aid in luminosity calibration problems. The work to date has taken place under grant OIP 75-22605 in the first year and renewal INT 75-22605 A01 in the second.

Parallax and proper motions of nearby stars are important in determining distances and motions that permit astronomers to derive true luminosity and, with other data, the masses of stars in double star systems. Motions furnish data for understanding the structure of the Milky Way and astrometric measures also supply the yardstick for calibration of the cosmic distance scale.

The photographic observations, which focus on white dwarfs and other stars of low luminosity, are obtained with the Mt. Stromlo 66-cm refractor and subsequently measured and reduced at the University of Virginia's observatory. A special effort is being made to coordinate the photographic observations of a small sample of stars accessible to both McCormick and Mt. Stromlo. The program affords a unique opportunity for detailed data comparison between a northern and a southern hemisphere refractor and an astrometric reflector to investigate sources of accidental and systematic errors in stellar parallaxes. D.S. Mathewson has replaced O.J. Eggen as the Australian principal investigator.

SUPPORTED BY U.S. National Science Foundation, Div. of International Programs

**10.0017, INFRARED STUDIES OF INTERSTELLAR AND CIRCUMSTELLAR MATERIALS**

*J.A. HACKWELL*, Univ. of Wyoming, School of Arts & Sciences, *Laramie, Wyoming* 82071 (AST77-07505 A01)

The composition and distribution of dust in space and the effect on the dust of its environment, for example, the radiation field, the gas density and the degree of ionization, will be studied using infrared astronomy techniques. The goal is to determine to what extent the dust observed in ionized hydrogen (HII) regions, in 'cold' interstellar space, and around late-type stars is related.

Dust in HII regions will be studied by making maps in the 8-13 micron and 16-25 micron spectral regions using array spectrometer systems developed at Wyoming and mounted on the University of Wyoming's 2.3-meter (92-inch) infrared telescope. Infrared line observations of HII regions will be made, particularly in heavily observed regions, to determine excitation conditions in the nebula. An indium-antimonide (InSb) system will be used to make sensitive 1-5 micron observations of line strengths and free-free emission in selected regions. The observations of dust in HII regions will be compared with measurements of infrared interstellar absorption bands and with spectral features observed in late-type stars and other heavily obscured objects.

The scheduling flexibility of the 2.3-m telescope will allow the study of dust formation is such transient events as novae when they occur. These studies will help us to understand dust formation mechanisms in other objects.

This is a continuation of work previously supported by NSF grant AST77-07505.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

## GENERAL

**11.0001, THE TELESCOPE AND THE ORIGINS OF THE CONCEPTS OF A 'SOLAR SYSTEM' - 1600-1700**

*A. VANHELDEN*, Rice University, Graduate School, *Houston, Texas* 77001 (F-77-167)

DESCRIPTION: To study the writings of 17th century astronomers in order to document the emergence of the concept of a solar system and how this concept was influenced by the telescope.

SUPPORTED BY U.S. National Foundation on the Arts & the Humanities, National Endowment for the Humanities

VOLUME 16 NUMBER 22 / NOVEMBER 23, 1978

# Scientific and Technical Aerospace Reports

*A Semimonthly Publication of the National Aeronautics and Space Administration*

## 01 AERONAUTICS (GENERAL)

**N78-31041*** + National Aeronautics and Space Administration, Washington, D. C.
**AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 98**
Jul. 1978 118 p refs
(NASA-SP-7037(98)) Avail: NTIS HC E02 CSCL 01A

This bibliography lists 399 reports, articles, and other documents introduced into the NASA scientific and technical information system in June 1978. Author

## 02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

**N78-31042** Stanford Univ., Calif.
**THE TRANSONIC FLOW ON A HELICOPTER ROTOR Ph.D. Thesis**
Francis Xavier Caradonna 1978 197 p
Avail: Univ. Microfilms Order No. 7814162

The flow on a hovering helicopter rotor operating at a supercritical tip Mach number is modeled using potential theory. The general potential equation is casted in blade-fixed coordinates and the transonic small disturbance approximation is invoked. The resulting equation only differs from its fixed-wing counterpart in having a spanwise increasing free-stream Mach number. Solutions shown use an arbitrary but not untypical vortex location and the strength is assumed to be the maximum blade circulation. Solutions obtained show the onset of supercritical flow and ultimately drag divergence. The drag divergence Mach number was considerably higher than that at which supercritical flow first occurs. Although there is some good comparison of computed results with fixed-wing-model data, there currently exists no body of hovering wake and load data adequate to test the present code. Dissert. Abstr.

**N78-31043*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**CONTROL-SURFACE HINGE-MOMENT CALCULATIONS FOR A HIGH-ASPECT-RATIO SUPERCRITICAL WING**
Boyd Perry, III Sep. 1978 26 p refs
(NASA-TM-78664; L-12219) Avail: NTIS HC A03/MF A01 CSCL 01A

The hinge moments, at selected flight conditions, resulting from deflecting two trailing edge control surfaces (one inboard and one midspan) on a high aspect ratio, swept, fuel conservative wing with a supercritical airfoil are estimated. Hinge moment results obtained from procedures which employ a recently developed transonic analysis are given. In this procedure a three dimensional inviscid transonic aerodynamics computer program is combined with a two dimensional turbulent boundary layer program in order to obtain an interacted solution. These results indicate that trends of the estimated hinge moment as a function of deflection angle are similar to those from experimental hinge moment measurements made on wind tunnel models with swept supercritical wings tested at similar values of free stream Mach number and angle of attack. J.M.S.

**N78-31044*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**ANALYSIS OF STABILITY CONTRIBUTIONS OF HIGH DIHEDRAL V-TAILS**
Carl E. Freeman (AVRADCOM Res. and Technol. Labs.) and William T. Yeager (AVRADCOM Res. and Technol. Labs.) Aug. 1978 22 p refs
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-78729; AVRADCOM-TR-78-34; L-12277) Avail: NTIS HC A02/MF A01 CSCL 01A

An investigation was undertaken to determine the effectiveness of four analytical methods (empirical, modified empirical, vortex-lattice, and an inviscid, three dimensional, potential flow, wing body program) to estimate the lateral and longitudinal static stability characteristics of an isolated V-tail wind tunnel model. The experimental tests were conducted in the V/STOL tunnel at a Mach number of 0.18. Angle-of-attack data were obtained from -12 deg to 8 deg at 0 deg sideslip. Sideslip sweeps from -5 deg to 10 deg were made at angles of attack of 4 deg, 0 deg and -4 deg. The V-tail dihedral angles were 45 deg, 50 deg, 55 deg, and 60 deg. B.B.

**N78-31045*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**AERODYNAMIC CHARACTERISTICS OF A HYPERSONIC RESEARCH AIRPLANE CONCEPT HAVING A 70 DEG SWEPT DOUBLE-DELTA WING AT MACH NUMBER 0.2**
Jim A. Penland, Theodore R. Creel, Jr., and James L. Dillon Sep. 1978 83 p refs
(NASA-TP-1252; L-12215) Avail: NTIS HC A05/MF A01 CSCL 01A

A wind-tunnel of the static longitudinal, lateral and directional stability characteristics of a hypersonic research airplane concept having a 70 deg swept double-delta wing was conducted in the Langley low-turbulence pressure tunnel. The configuration variables included wing planform, tip fins, center fin, and scramjet engine modules. A mach number of 0.2 was investigated over a Reynolds number (based on fuselage length) range of 2,200,000 to 19.75 x 1,000,000 (with a majority of tests at 10.0 x 1,000,000. Tests were conducted through an angle-of-attack range from about -2 deg to 34 deg at angles of sideslip of 0 deg to 5 deg, and at elevon deflection of 0 deg, -5 deg, -10 deg, -15 deg, and -20 deg. The drag coefficient of the integrated scramjet engine appears relatively constant with Reynolds number at the test Mach number of 0.2. Mild pitch-up was exhibited by the models equipped with tip fins. The forward delta, a highly swept forward portion of the wing, was destabilizing. The center fin model has a higher trimmed maximum lift-drag

ratio and a wider trim lift and angle-of-attack range than the tip fin model. Both the tip fin models and center fin models exhibited positive dihedral effect and positive directional stability. Roll control was positive for the tip fin model, but yaw due to roll control was unfavorable. Author

**N78-31046#** Naval Air Test Center, Patuxent River, Md. Strike Aircraft Test Directorate.

**MAXIMUM LIKELIHOOD IDENTIFICATION OF THE LONGITUDINAL AERODYNAMIC COEFFICIENTS OF THE EA-6B AIRPLANE IN THE CATAPULT LAUNCH CONFIGURATION**

David E. Bischoff 8 May 1978 34 p refs
(AD-A054243; NATC-TM-78-2-SA) Avail: NTIS HC A03/MF A01 CSCL 01/3

The aerodynamic coefficients describing the longitudinal equations of motion of the EA-6B airplane with landing gear and flaps down were determined from flight test data through use of a maximum likelihood identification algorithm. These identified coefficients were accurately determined and were utilized to both: (1) predict short and long period time history responses and (2) duplicate the results of conventional flight test specification requirement test procedures. The identified results provide an example of the type of information available through the application of parameter estimation technology in the areas of airplane data base generation. These data can be utilized for ACLS and Operational Flight Trainer simulations as well as for parametric studies of aerodynamic characteristics. Author (GRA)

**N78-31047#** Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.

**TWO-DIMENSIONAL SUBSONIC WIND TUNNEL EVALUATION OF TWO RELATED CAMBERED 15-PERCENT THICK CIRCULATION CONTROL AIRFOILS Final Report**

Jane Abramson Sep. 1977 68 p refs
(AD-A055140; DTNSRDC/ASED-373) Avail: NTIS HC A04/MF A01 CSCL 20/4

Two circulation control cambered elliptic airfoil sections with a thickness-to-chord ratio of 0.15 and 1.0 percent circular arc camber were evaluated subsonically to determine their aerodynamic characteristics. The two models, designated NCCR 1510-7067N and NCCR 1510-7567S, have a common leading edge but different Coanda surfaces. GRA

**N78-31048#** Hydronautics, Inc., Laurel, Md.

**MEASUREMENTS AND ANALYSIS OF THE FORCES ACTING ON A SMALL AIRCRAFT FLYING IN THE UPWASH OF A LARGE AIRCRAFT Final Report, 1 Jan. 1976 - 31 Dec. 1977**

Clinton E. Brown, Peter VanDyke, and John W. Kloetzli Apr. 1978 30 p refs
(Contract F44620-76-C-0073; AF Proj. 2307)
(AD-A055286; TR-7615; AFOSR-78-0903TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

Preliminary analysis of the expected ranges of forces and moments were made using available theoretical methods and confirming experiments were performed in the Hydronautics Ship Model Basin. The tests used a large model of the Boeing 747 transport aircraft and a smaller model typifying a fighter-type aircraft. The range of positions of the small model relative to the large model extended laterally 30 full-scale feet from the wing tip or from the tip vortex and downstream roughly 80 feet behind the wing tip. Consideration was given to the problem of maintaining steady position at a point that provided a maximum increase in the lift to drag ratio (L/D) of the small aircraft. The model tests have shown that an increase of 50% in L/D can be obtained by a small fighter-type aircraft flying close to the tip trailing vortex of a larger aircraft. Higher increases in L/D for the same relative aircraft positions would result if the smaller aircraft exhibited higher performance (max L/D was 8.9 in free air). Calculations made for the models tested indicate that control power of typical fighters would be sufficient to maintain level flight in the favorable positions close to a tip vortex. GRA

**N78-31049#** Army Armament Research and Development Command, Aberdeen Proving Ground, Md. Ballistics Research Lab.

**AEROBALLISTICS OF CORKSCREW PROJECTILES Final Report**

Anders S. Platou Apr. 1978 33 p refs Supersedes BRL-IMR-541
(AD-A054735; AD-E430032; ARBRL-MR-02825; BRL-IMR-541) Avail: NTIS HC A03/MF A01 CSCL 19/1

Preliminary wind tunnel and aeroballistic range tests on a new and novel exterior projectile shape have shown that this 5 caliber to 8 caliber long shape has extremely good aerodynamic characteristics. It not only has very low drag, but also low pitching and Magnus moments which in turn yield good gyroscopic and good dynamic stability. Extrapolation of the data to longer lengths indicates that 10 caliber to 12 caliber long projectiles having this shape can be flown with satisfactory stability. Author (GRA)

**N78-31050#** Grumman Aerospace Corp., Bethpage, N.Y.

**AN AUTOMATED PROCEDURE FOR COMPUTING THE THREE-DIMENSIONAL TRANSONIC FLOW OVER WING-BODY COMBUSTIONS, INCLUDING VISCOUS EFFECTS. VOLUME 2: PROGRAM USER'S MANUAL AND CODE DESCRIPTION. APPENDIX A: COMPUTER CODE LISTING AND FLOWCHART Final Report, 1 May 1975 - 1 Oct. 1977**

William H. Mason, Donald Mackenzie, Mark Stern, William F. Ballhaus, and Juanita Frick Feb. 1978 705 p refs
(Contract F33615-75-C-3073)
(AD-A055109; AFFDL-TR-77-122-Vol-2-App-A) Avail: NTIS HC A99/MF A01 CSCL 20/4

This appendix volume contains the program listing and flowchart for the program described in Volume 1 and Volume 2. The program is a numerical method that predicts the detailed pressure distribution on wing-body combinations at transonic Mach numbers less than one and integrates the pressures to obtain aircraft force and moment data. The code has been developed with the intent of providing the user with an easy to use and reliable tool. The basic inviscid prediction method is the modified transonic small disturbance theory program. In order to provide accurate surface pressure predictions on the wing, several additional features of the typical transonic flowfield have been incorporated. These consist of the viscous displacement effect, local strong viscous interaction at the shock wave foot and at the trailing edge (including an approximate treatment of local shallow separations), and finally, the interaction effect of the fuselage. GRA

**N78-31051#** ARO, Inc., Arnold Air Force Station, Tenn.

**RESULTS OF A WIND TUNNEL AND FLIGHT TEST PROGRAM TO DEVELOP A MAXIMUM VOLUME BOMB (MVB) CONFIGURATION FOR MULTIPLE CARRIAGE AND SEPARATION FROM TACTICAL-AIRCRAFT AT MACH NUMBERS FROM 0.50 TO 1.10 Final Report, 4 Feb. 1975 - 21 May 1976**

David W. Hill, Jr. AEDC May 1978 179 p refs
(AF Proj. 2567)
(AD-A055029; AEDC-TR-78-4; AFATL-TR-78-4) Avail: NTIS HC A09/MF A01 CSCL 19/2

Wind tunnel tests, supported by flight test data, were conducted in order to determine separation characteristics of a 16 in. diam maximum volume bomb (MVB) from the inboard-pylon triple ejection rack (TER) on the F-4C aircraft. The wind tunnel tests were conducted to obtain static and dynamic stability data on the store in the free stream, and captive trajectory data on the store when released from the F-4C and A-7D aircraft. The fins of the MVB were canted from 0 to -12 deg, with and without fin tabs, to assess their effectiveness in reducing the severe nose-down pitch motion encountered during separation at high subsonic Mach numbers. The tests were conducted at Mach numbers from 0.50 to 1.10 at simulated pressure altitudes of 5,000 and 20,000 ft. The wind tunnel tests indicated, at all Mach numbers, that the nose-down pitch motion of the store was significantly reduced by canting the fins. However, the flight tests at Mach number 0.90 indicated that the severe nose-down pitch motion continued even with the canted fins. GRA

**N78-31052#** Grumman Aerospace Corp., Bethpage, N.Y.

**AN AUTOMATED PROCEDURE FOR COMPUTING THE THREE-DIMENSIONAL TRANSONIC FLOW OVER WING-BODY COMBINATIONS, INCLUDING VISCOUS EFFECTS. VOLUME 1: DESCRIPTION OF ANALYSIS METHODS AND**

**APPLICATIONS Final Report, May 1975 - Oct. 1977**
William H. Mason, Donald Mackenzie, Mark Stern, William F. Ballhaus, and Juanita Frick Feb. 1978 220 p refs
(Contract F33615-75-C-3073)
(AD-A055899; AFFDL-TR-77-122-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 20/4

This report describes a numerical method to predict the detailed pressure distribution and force and moment results for wing-body combinations at transonic Mach numbers less than one. The resulting computer code has been developed with the intent of providing the user with an easy to use and reliable tool that produces the most accurate possible engineering predictions. In order to provide accurate surface pressure predictions on the wing, several additional features of the typical transonic flow field have been incorporated. These consist of the viscous displacement effect, local strong viscous interaction at the shock wave foot and at the trailing edge (including an approximate treatment of local shallow separations), and finally, the interaction effect of the fuselage. GRA

**N78-31053#** North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
**DEVELOPMENT OF A COMPUTER PROGRAM TO CALCULATE AERODYNAMIC CHARACTERISTICS OF BODIES AND WING-BODY COMBINATIONS Interim Report, 15 Dec. 1976 - 15 Dec. 1977**
Fred R. DeJarnette and Kenneth M. Jones Mar. 1978 78 p refs
(Contract N60921-77-C-A066)
(AD-A055846; NSWC/DL-TR-3829) Avail: NTIS HC A05/MF A01 CSCL 20/4

A new method has been developed for calculating an approximate surface pressure distribution over axisymmetric bodies, with pointed or blunted noses, at angle of attack in supersonic flow. A modified form of the second-order shock-expansion method is developed and matched to modified Newtonian theory near the nose. Surface pressure distributions compared well with experimental data on blunted cones with and without flares at Mach numbers from 1.5 to 4.63 and angles of attack to 12 deg. Author (GRA)

**N78-31054#** Sandia Labs., Livermore, Calif.
**HYBRID TRAJECTORY SIMULATION OF A PARACHUTE SYSTEM**
W. R. Bolton Apr. 1978 22 p refs
(Contract EY-76-C-04-0789)
(SAND-78-8668) Avail: NTIS HC A02/MF A01

A two parachute system which allows delivery of a payload from high speed and very low altitude while providing an acceptable low impact velocity was developed. A hybrid computer simulation of the parachute delivery system is described. ERA

**N78-31055#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
**THE DESIGN AND AERODYNAMIC CHARACTERISTICS OF THE RAE 5215 AEROFOIL**
P. G. Wilby London Aeron. Res. Council 1977 73 p refs Supersedes RAE-TR-74172; ARC-36124
(ARC-CP-1386; BR61583; RAE-TR-74172; ARC-36124) Avail: NTIS HC A04/MF A01; HMSO £3; PHI $11.55

The design and aerodynamic characteristics of a series of airfoils leading to the RAE 5215 airfoil are described. This 9.7% thick section was developed to achieve a drag-rise Mach number of about 0.8 with a lift coefficient of 0.4, without suffering from a rear separation at low Reynolds numbers. Section characteristics are compared with those of a thicker section (RAE 5212) designed for operation at lower Mach numbers. Author (ESA)

**N78-31056#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Experimentelle Aerodynamik.
**INVESTIGATIONS OF A HIGHLY LOADED COMPRESSOR CASCADE WITH A CONTROL OF THE BLADE BOUNDARY LAYER. PART 5: EXPERIMENTAL INVESTIGATIONS ON THE CASCADE WITH SLOTTED BLADES [UNTERSUCHUNGEN AN EINEM HOCHBELASTETEN VERDICHTERGITTER MIT BEEINFLUSSUNG DER SCHAUFELGRENZSCHICHT. TEIL 5: EXPERIMENTELLE UNTERSUCHUNGEN AM GITTER MIT SPALTSCHAUFELN]**
R. Kiock Oct. 1977 80 p refs In GERMAN Prepared jointly with Motoren - U. Turbinen Union GmbH, Munich Report will also be announced as translation (ESA-TT-479)
(DLR-IB-151-77/14) Avail: NTIS HC A05/MF A01

Slotted compressor blades in the form of a plane blade were tested in a high velocity wind tunnel. Wake, pressure distribution, and boundary layer measurements were made for incompressible flow and for compressible subsonic flow. The measurement results are discussed. ESA

**N78-31057#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Flugkoerperantriebe.
**THE DETERMINATION OF THE LAVAL NOZZLE EXIT CONDITIONS AT TOO HIGH COUNTERPRESSURE, ESPECIALLY FOR A PROPANE OXYGEN GAS GENERATOR**
Egbert Riester 21 Oct. 1977 40 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-504)
(DLR-FB-77-45) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 21,60

The flow conditions in a supersonic nozzle including normal shock were investigated. A more dimensional calculation method for an ideal gas to compute the nozzle exit parameters and the location of the shock is presented. The boundaries of the pressure behind the nozzle were calculated. For gas from the combustion of propane and oxygen is shown that the consequences of real gas effects on the results of the method are small. Experimental measurements on nozzles with air flow show the validity of the method. At a propane oxygen gas generator the exhaust gas temperature is very high, therefore measurements are only possible in the jet behind the nozzle exit. The pitot pressure and the temperature measurements show that the chemical reaction in the combustion chamber was incomplete. Author (ESA)

**N78-31058#** Durham Univ. (England).
**WALL BOUNDARY LAYERS IN CASCADES**
H. Marsh London Aeron. Res. Council 1978 22 p refs Supersedes ARC-37358
(ARC-CP-1388; ARC-37358) Avail: NTIS HC A02/MF A01; HMSO £1.50; PHI $5.80

Six theories for the wall boundary layer development are presented. Their predictions for the change of momentum thickness caused by the turning of an inviscid shear flow are compared to the experimental results. It is shown that three theories give predictions which are in close agreement with experimental data and this suggests that the inviscid re-adjustment of the flow is the dominant effect in many cascades. The momentum and energy approaches are discussed and the further development of the energy approach is recommended. Author (ESA)

**N78-31059#** Royal Aircraft Establishment, Farnborough (England).
**LAMINAR FLOW-FIELD COMPUTATION IN AXISYMMETRIC NOZZLES**
B. C. Barber Nov. 1977 34 p refs
(RAE-TR-77175; BR61832) Avail: NTIS HC A03/MF A01

A numerical procedure for computing the laminar flow-field in nozzles at throat Reynolds numbers of 300-3000 is described. Such nozzles are found in spacecraft position control thrusters, chemical lasers, and low density hypersonic wind-tunnels. A parabolic approximation of the Navier-Stokes equations (the 'boundary layer equations') is transformed to von Mises form and solved numerically by a central difference method. The entire subsonic and supersonic flow-field is computed. No assumptions or approximations, other than those inherent in the flow equations, are involved. The method is of the direct type and the flow-field for any given nozzle geometry may, in principle, be computed. Examples are given comparing computed results with published experimental data. Author (ESA)

**N78-31060#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Dynamik Verduennter Gase.

**MOLECULAR TWO-DIMENSIONAL FLOW OF MIXTURES OF LIGHT AND HEAVY GASES WITH DIFFUSE AND SPECULAR REFLECTION**

Walter Wuest 25 Nov. 1977 26 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-508)

(DLR-FB-77-51) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 14,40

As a simpler case of the proposed Spacelab experiment in which the extreme vacuum at the Lee-side of a shield is utilized for flow experiments. Two-dimensional density fields were calculated for diffuse and specular reflection for the flow around a plate strip and a half cylinder, facing either the convex or the concave side of the flow. In the latter case the specularly reflected molecules are focused with strong compression (focused or caustic flow fields). Author (ESA)

# 03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

**N78-31061*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**SIMULTANEOUS MEASUREMENTS OF OZONE OUTSIDE AND INSIDE CABINS OF TWO B-747 AIRLINERS AND A GATES LEARJET BUSINESS JET**

Porter J. Perkins and Daniel Briel 1978 11 p refs Proposed for presentation at the Conf. on Atmospheric Environ. of Aerospace Systems and Appl. Meteorology, New York, 13-16 Nov. 1978; sponsored by the Am. Meteorol. Soc. and the AIAA

(NASA-TM-78983; E-9760) Avail: NTIS HC A02/MF A01 CSCL 06T

The average amount of ozone measured in the cabins of two B-747 airliners varied from 40 percent to 80 percent of the atmospheric concentrations without special ozone destruction systems. A charcoal filter in the cabin air inlet system of one B-747 reduced the ozone to about 5 percent of the atmospheric concentration. A Learjet 23 was also instrumented with monitors to measure simultaneously the atmospheric and ozone concentrations. Results indicate that a significant portion of the atmospheric ozone is not destroyed in the pressurization system and remains in the aircraft cabin of the Learjet. For the two cabin configurations tested, the ozone retentions were 63 and 41 percent of the atmospheric ozone concentrations. Ozone concentrations measured in the cabin near the conditioned-air outlets were reduced only slightly from atmospheric ozone concentrations. It is concluded that a constant difference between ozone concentrations inside and outside the cabin does not exist. G.G.

**N78-31062#** Civil Aeromedical Inst., Oklahoma City, Okla.

**GPSS COMPUTER SIMULATION OF AIRCRAFT PASSENGER EMERGENCY EVACUATIONS**

J. D. Garner, R. F. Chandler, and E. A. Cook Jun. 1978 18 p refs

(AD-A056098; FAA-AM-78-23) Avail: NTIS HC A02/MF A01 CSCL 06/7

A method to simulate civil aircraft evacuations, by use of a computer model based on statistics from measured components of the escape path, was developed. This model used the General Purpose Simulation System (GPSS) computer programming language to represent various features of the escape process; e.g., seating and exit configurations, passenger mix, door-opening delays, time on escape slides, slide capacity, and redirection of passengers to equalize escape lines. Results of simulated evacuations from the DC-10, L-1011, and B-747 aircraft and a military aircraft are reported. These results have been compared with results of certification demonstrations from the DC-10, L-1011, and B-747. Comparisons of exit size substitutions were evaluated as a means of estimating differences in escape potential for exit design optimization. G.G.

**N78-31063#** Naval Air Engineering Center, Lakehurst, N.J. Ground Support Equipment Dept.

**SAFETY ANALYSIS LOX-30 LIQUID OXYGEN GENERATOR Final Technical Report**

R. Ferret May 1978 51 p

(AD-A054804; NAEC-92-122) Avail: NTIS HC A04/MF A01 CSCL 13/9

Safety of the LOX-30 Liquid Oxygen Generator was evaluated in accordance with MIL-STD-882. Thirteen safety/control devices and fifteen operational areas were extensively analyzed. Twenty-seven hazard classifications were assigned. Location of the storage vessel relief valve presents a severe personnel hazard. Incorporation of a shield around this relief valve to protect personnel would mitigate this hazard. No other significant safety hazards were identified. Author (GRA)

**N78-31064#** Rockwell International Corp., Los Angeles, Calif.

**HAZARD ASSESSMENT OF AIRCRAFT GUN COMPARTMENTS Final Report, May 1976 - Oct. 1977**

William A. Pace Dec. 1977 240 p refs

(Contract F33615-76-C-2051)

(AD-A055026; NA-77-938; AFAPL-TR-77-79) Avail: NTIS HC A11/MF A01 CSCL 19/6

Aircraft gun compartments provide an inherent fire/explosion risk potential because of the common location of flammable fluids, thermal ignition source, and various environmental conditions. This program, while specifically addressing the hazards associated with aircraft gun compartments, investigated other related area of concern. The areas include gun compartment hazard identification, accident/incident reports, historical data on aircraft gun compartment design and evaluation, development of a hazard assessment methodology, the chemical composition and behavior of typical gun gases, and various types of sensors to detect and measure combustible gases. The results of the study were used to prepare technical design guidance for possible inclusion in the Armament Handbook DH2-5. Author (GRA)

**N78-31065#** Coast Guard, Washington, D.C. Office of Merchant Marine Safety.

**INFLATABLE LIFERAFT TESTS IN THE PACIFIC OCEAN OFF THE COLUMBIA RIVER BAR Final Report**

R. L. Markle, S. E. Wehr, M. R. Daniels, and S. G. Maness 3 May 1978 27 p

(AD-A055323; USCG-M-4-78) Avail: NTIS HC A03/MF A01 CSCL 06/7

This report presents the results of various exercises with inflatable liferafts having large water ballast systems for improved stability. The exercises were conducted in the Pacific Ocean near the Columbia River Bar. The report describes the exercises in detail and analyzes the results. The investigation described is one of a planned series of investigations into the characteristics of inflatable liferafts in heavy winds and high seas.

Author (GRA)

**N78-31066#** National Technical Information Service, Springfield, Va.

**SEARCH AND RESCUE METHODS AND EQUIPMENT. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - Jun. 1978**

Edith Kenton Jun. 1978 202 p Supersedes NTIS/PS-77/0498; NTIS/PS-76/0285

(NTIS/PS-78/0539/3; NTIS/PS-77/0498; NTIS/PS-76/0285) Avail: NTIS HC $28.00/MF $28.00 CSCL 06G

A bibliography containing 196 abstracts concerning search and rescue on land and sea is presented. The majority of the citations cover sea search and rescue, although much is applicable to land search and rescue. Studies are included on search and rescue planning, searching strategies, locating equipment, rescue beacons, communication devices, specialized aircraft and their components, as well as other rescue and searching equipment and techniques. GRA

# 04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

**N78-31067*#** Ohio Univ., Athens. Dept. of Electrical Engineering.

**COMPUTING LORAN TIME DIFFERENCES WITH AN HP-25 HAND CALCULATOR**

Edwin D. Jones Aug. 1978 11 p refs
(Grant NGR-36-009-017)
(NASA-CR-157580; TM-59) Avail: NTIS HC A02/MF A01 CSCL 17G

A program for an HP-25 or HP-25C hand calculator that will calculate accurate LORAN-C time differences is described and presented. The program is most useful when checking the accuracy of a LORAN-C receiver at a known latitude and longitude without the aid of an expensive computer. It can thus be used to compute time differences for known landmarks or waypoints to predict in advance the approximate readings during a navigation mission. B.B.

**N78-31068*#** Ohio Univ., Athens. Dept. of Electrical Engineering.

**PHASE-LOCKED TRACKING LOOPS FOR LORAN-C**

R. W. Burhans Aug. 1978 25 p
(Grant NGR-36-009-017)
(NASA-CR-157582; TM-60) Avail: NTIS HC A02/MF A01 CSCL 17G

Portable battery operated LORAN-C receivers were fabricated to evaluate simple envelope detector methods with hybrid analog to digital phase locked loop sensor processors. The receivers are used to evaluate LORAN-C in general aviation applications. Complete circuit details are given for the experimental sensor and readout system. Author

**N78-31069*#** Ohio Univ., Athens. Dept. of Electrical Engineering.

**LORAN-C FLIGHT TEST SOFTWARE**

James D. Nickum Aug. 1978 41 p refs
(Grant NGR-36-009-017)
(NASA-CR-157581; TM-61) Avail: NTIS HC A03/MF A01 CSCL 17G

The software package developed for the KIM-1 Micro-System and the Mini-L PLL receiver to simplify taking flight test data is described along with the address and data bus buffers used in the KIM-1 Micro-system. The interface hardware and timing are also presented to describe completely the software programs. B.B.

**N78-31070#** National Aviation Facilities Experimental Center, Atlantic City, N. J.

**TRSB MICROWAVE LANDING SYSTEM DEMONSTRATION PROGRAM AT JOHN F. KENNEDY INTERNATIONAL AIRPORT, LONG ISLAND, NEW YORK, USA Final Report, Dec. 1977 - Jan. 1978**

4 Jan. 1978 134 p
(AD-A055447; FAA-NA-78-16; FAA-RD-78-16) Avail: NTIS HC A07/MF A01 CSCL 17/2

The TRSB (Time Reference Scanning Beam) system was demonstrated at JFK airport in December 1977 and consisted of a 1 degree phased array azimuth subsystem, a 1.5 degree elevation subsystem with an antenna of the Rotman lens design, and a precision L-Band DME. A laser tracker was provided for precise aircraft position data but was considered unusable. However, TRSB airborne recordings are available for several flights and provide useful data output. During the operational demonstrations, national and international observers in the NASA B-737 aircraft flew the Canarsie approaches, under fully coupled and manual flight conditions to touchdown and rollout. These demonstrations highlighted the important capability of Microwave Landing Systems to provide precision guidance over complex approach paths to a busy international airport. G.Y.

**N78-31071#** National Aviation Facilities Experimental Center, Atlantic City, N. J.

**TRSB MICROWAVE LANDING SYSTEM DEMONSTRATION PROGRAM AT KRISTIANSAND, NORWAY Final Report, 15-17 Jan. 1978**

Jan. 1978 82 p
(AD-A055317; FAA-NA-78-17; FAA-RD-78-17) Avail: NTIS HC A05/MF A01 CSCL 01/2

A demonstration of Kjevik Airport, Kristiansand, Norway, was the fifth in a series of operational demonstrations of several TRSB system configurations at selected airports in the United States and abroad. Operational demonstrations and data acquisition flights were made utilizing an FAA Boeing 727 test aircraft. Flight profiles included approaches, radials, and partial orbits perpendicular to the runway centerline. Some flight tests were also made by Norwegian and British Civil Aviation Authority personnel using TRSB equipment installed in their respective flight inspection aircraft. Results of the operational demonstrations indicated that the performance of both system configurations was well within their respective U.S. program design requirements and also met ICAO (AWOP) full capability system requirements. B.B.

**N78-31072#** National Aviation Facilities Experimental Center, Atlantic City, N. J.

**TRSB MICROWAVE LANDING SYSTEM DEMONSTRATION PROGRAM AT CHARLEROI, BELGIUM Final Report, 18 Jan. - 6 Feb. 1978**

Feb. 1978 52 p
(AD-A055920; FAA-NA-78-19; FAA-RD-78-19) Avail: NTIS HC A04/MF A01 CSCL 01/4

A demonstration was held at Gosselies Airport, Charleroi, Belgium in conjunction with the United States TRSB demonstration program, and was the sixth in a series of operational demonstrations of several TRSB system configurations at selected airports in the United States and abroad. Operational demonstrations were made utilizing FAA Boeing 727 and Convair 880 test aircraft. Flight performance data was acquired with the Boeing 727 test aircraft only. Flight profiles included approaches on centerline and offset plus and minus 1 and 2 degrees at various elevation angles, and radials at constant altitude on centerline and offset plus and minus 10 degrees. Results of the operational demonstrations indicated that the performance of the TRSB Small Community azimuth subsystem met ICAO (AWOP)full capability systems requirements. B.B.

**N78-31073#** Westinghouse Defense and Electronic Systems Center, Baltimore, Md.

**CAPTURE EFFECT ARRAY GLIDE SLOPE GUIDANCE STUDY Interim Report**

J. T. Godfrey, H. F. Hartley, R. A. Moore, and G. J. Moussally Mar. 1978 95 p
(Contract DOT-FA74WA-3353)
(AD-A055678; FAA-RD-78-41) Avail: NTIS HC A05/MF A01 CSCL 17/7

The performance of the capture effect glide slope array as a function of the quality and quantity of required ground planes was examined. Methods of improvement were also investigated: Wherein either a smoothing of the glide path structure or a reduction of the required ground plane was considered an improvement. An extensive computer model was developed and it was used to study the effect on glide path DDM of different position arrangements of elements. It was found that a unique arrangement of elements could be found for any terrain environment which would give a zero DDM along the entire glide path up to threshold. G.Y.

**N78-31074#** Lincoln Lab., Mass. Inst. of Tech., Lexington.

**IPC DESIGN VALIDATION AND FLIGHT TESTING Final Report**

J. W. Andrews, J. C. Koegler, and K. D. Senne 31 Mar. 1978 267 p refs
(Contracts DOT-FA72WAI-261; F19628-78-C-0002; Proj. 034-241-012)
(AD-A055529; ATC-85; FAA-RD-77-150) Avail: NTIS

HC A12/MF A01 CSCL 01/4

A series of flight tests were conducted to evaluate the collision avoidance system known as intermittent positive control (subsequently re-named automatic traffic advisory and resolution service, ATARS). These tests involved both professional test pilots and subject pilots selected from the aviation community. Analysis of the collision avoidance algorithm, pilot visual acquisition performance, and pilot reaction to avoidance instructions are also included. B.B.

**N78-31075#** Federal Aviation Administration, Washington, D. C.

**IFR AIRCRAFT HANDLED FORECAST BY AIR ROUTE TRAFFIC CONTROL CENTER, FISCAL YEARS 1978-1989**

Bernard Hannan Nov. 1977 51 p

(AD-A049305; FAA-AUP-77-34) Avail: NTIS HC A04/MF A01 CSCL 17/7

The forecasts of instrument flight rule aircraft handled by FAA air route traffic control centers are presented. They serve as a base for the FAA planning and budget process in determining future requirements for facilities, equipment and manpower. The forecasts show that total aircraft handled will increase from 25.7 million FY 1977 to 41.5 million in FY 1989. These national total numbers along with those for the intervening years are broken down by FAA region and by each air route traffic control center in this report. G.G.

**N78-31076#** Committee on Science and Technology (U. S. House).

**FUTURE NEEDS AND OPPORTUNITIES IN THE AIR TRAFFIC CONTROL SYSTEM**

Washington GPO 1977 716 p refs Hearings before Subcomm. on Transportation, Aviation and Weather of the Comm. on Sci. and Technol., 95th Congr., 1st Sess., 8-9, 14-16 Jun.; 8 Sep. 1977

(GPO-98-931) Avail: Subcomm. on Transportation, Aviation and Weather

Testimony concerning the philosophies and issues related to future or post third generation air traffic control (ATC) systems is presented. Research and development programs, microwave landing systems, wind shear, wake vortex, availability of energy, and the economic climate are among the factors considered. Emphasis is placed on the enhancement of system capacity, safety, and productivity. Aviation demands of the public are projected through the turn of the century in terms of expansion of ATC services. J.M.S.

**N78-31077#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**A DESIGN OF TRAJECTORY ESTIMATOR USING MULTIPLE DME RANGE MEASUREMENTS M.S. Thesis**

Robert Riggins Mar. 1978 134 p refs

(AD-A055191; AFIT/GGC/EE/78-4) Avail: NTIS HC A07/MF A01 CSCL 17/7

This report is directed toward the design of a real-time estimation algorithm, a Kalman filter, that estimates aircraft position and velocity using multiple DME range measurements. The estimator is designed and tested for feasibility as a reference system for examining Inertial Navigational System (INS) low frequency errors. Both a 9 state estimator including jerk states and a 7 state estimator without the jerk states are designed. GRA

**N78-31078#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**PERFORMANCE IN A JAMMING ENVIRONMENT OF A LOW-COST GPS USER RECEIVER ALGORITHM FOR AIDING A TACTICAL INS M.S. Thesis**

Stephen E. Cross Dec. 1977 133 p refs

(AD-A055239; AFIT/EE/GGC/77-2) Avail: NTIS HC A07/MF A01 CSCL 17/4

The design and evaluation of a position and velocity estimation algorithm for a low-cost Global Positioning System (GPS) user receiver is presented. The algorithm is intended as a navigation aid for a tactical aircraft. The algorithm is based on linearized range and range rate equations using the INS indicated position and velocity and the GPS user receiver's measured range and range rate. Hotelling's iterative matrix inversion algorithm is used to invert a (4 x 4) measurement matrix. A feedback and feedforward mechanization is proposed for the estimation algorithm. The performance is based on simulations using a dynamic F-4 flight profile. Comparisons are made with results obtained from a Carlson Square Root Filter and an unaided INS. Author (GRA)

**N78-31079#** National Bureau of Standards, Washington, D. C. Inst. for Basic Standards.

**STATISTICAL MODEL FOR RANDOM ERRORS OF POSITION LOCATION BASED ON LINES OF POSITION Final Report**

Joan R. Rosenblatt Mar. 1978 15 p

(PB-281158/6; NBSIR-78-1457) Avail: NTIS HC A02/MF A01 CSCL 17G

The U.S. Coast Guard has proposed that procedures for routine determination of positions be revised to include redundant observations for assessing precision and accuracy of the results. This report provides a statistical model and a method for calculating a confidence region for the position location. GRA

**N78-31080#** Research Inst. of National Defence, Stockholm (Sweden).

**THEORETICAL AND EXPERIMENTAL INVESTIGATION OF COMPUTATION ERRORS IN TWO DIFFERENT STRAPDOWN INERTIAL NAVIGATION (IN)-SYSTEMS**

Karl-Erik Olsson Feb. 1978 151 p refs

(FOA-C-20217-E4) Avail: NTIS HC A08/MF A01

Some aspects of design of strapdown IN-systems are discussed. Based upon investigations of suitable algorithms, suggestions concerning data processing and computer instrumentation in a strapdown IN-system are made, and two different system configurations are outlined. Also a procedure of selecting algorithm and assigning appropriate parameter-values in order to meet a specified demand for computation accuracy is described. A description of the instrumentation of a strapdown IN-system for experimental investigations and results from some measurements performed on the system are given. Author (ESA)

**N78-31081#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

**SOME IMPORTANT RESULTS OBTAINED IN THE ANALYSIS OF NEAR MIDAIR AND MIDAIR COLLISIONS**

Otto Weber 14 Jun. 1977 38 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-499)

(DLR-FB-77-25) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 17.70

Theoretical studies concerning the analysis of near midair and midair collisions under visual meteorological conditions were made. The applicability of the rules of the air for pilots approaching a powered glider or flying in the critical area between converging courses and overtaking is studied. The effectiveness of horizontal evasive maneuvers in this area was examined using some examples. Restrictions on a pilot's ability to see an approaching aircraft caused by meteorological phenomena, too small dimensions of the aircraft, the workload of the observing pilot, and by opaque structures in his cockpit are discussed for horizontal turns and straight and level flight. The apparent tracks of straight and level flying aircraft on the windshield of an aircraft in straight and level flight or in a horizontal turn are treated and the limits of the 'see and avoid' concept are described. The results are applicable to initial training and advanced instruction of pilots. Author (ESA)

**N78-31082#** General Accounting Office, Washington, D. C. Procurement and Systems Acquisition Div.

**STATUS OF THE NAVSTAR GLOBAL POSITIONING SYSTEM Report to the Congress**

25 Apr. 1978 30 p refs

(PB-280316/1; PSAD-78-37) Avail: NTIS HC A03/MF A01 CSCL 17G

The Air Force is developing the NAVSTAR Global Positioning System for precise world wide positioning or navigation. It will be used by the Air Force, Navy, and Army and possibly by military allies and civilians. Developmental problems have delayed the program about 1 year. Beginning in July 1978 through

February 1979, the system will be tested to see how well it performs military applications. GRA

# 05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

**N78-31083** Iowa State Univ. of Science and Technology, Ames.
**TRAJECTORY OPTIMIZATION FOR SOME SAILPLANE PERFORMANCE PROBLEMS Ph.D. Thesis**
Imao Chen 1978 217 p
Avail: Univ. Microfilms Order No. 78-13220

Three specific sailplane performance problems are formulated as optimal control problems and studied: (1) minimum landing-approach distance problem; (2) minimum altitude-loss problems in the presence of sinusoidal vertical winds; and (3) minimum time problems in the presence of sinusoidal vertical winds. Both minimum altitude-loss and minimum time problems have several cases involved: (1) fixed and equal initial and final states; (2) free but equal initial and final states; (3) effects of varying the wind amplitude; (4) effects of varying the fixed range; and (5) wing-loading effects. One more case of effects of varying the prescribed altitude loss for minimum time problems is also studied. Dissert. Abstr.

**N78-31084** Purdue Univ., Lafayette, Ind.
**EFFECTS OF DYNAMIC AEROELASTICITY ON HANDLING QUALITIES AND PILOT RATING Ph.D. Thesis**
Wen-Yo Yen 1977 122 p
Avail: Univ. Microfilms Order No. 78-13142

Pilot performance parameters, such as pilot ratings, tracking errors, and pilot comments were determined for a longitudinal pitch tracking task using a large, flexible bomber with parametric variations in the undamped natural frequencies of the two lowest frequency symmetric elastic modes. This pitch tracking task was programmed on a fixed base simulator with an electronic attitude-director display of pitch command, pitch angle, and pitch error. The results of this study indicate that low-frequency structural flexibility can significantly affect the handling qualities and pilot ratings in the task evaluated. Dissert. Abstr.

**N78-31085*#** Lockheed-California Co., Burbank.
**STUDY OF FUEL SYSTEMS FOR LH2-FUELED SUBSONIC TRANSPORT AIRCRAFT, VOLUME 1 Final Report, Sep. 1976 - Dec. 1977**
G. D. Brewer, R. E. Morris, G. W. Davis, E. F. Versaw, G. R. Cunnington, Jr. (Lockheed Missiles and Space Co., Inc.), J. C. Riple (AiResearch Mfg. Co.), C. F. Baerst (AiResearch Mfg. Co.), and G. Garmong (Rocketdyne) Jul. 1978 202 p 2 Vol.
(Contract NAS1-14614)
(NASA-CR-145369-Vol-1; LR-28384-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 01C

Several engine concepts examined to determine a preferred design which most effectively exploits the characteristics of hydrogen fuel in aircraft tanks received major emphasis. Many candidate designs of tank structure and cryogenic insulation systdms were evaluated. Designs of all major elements of the aircraft fuel system including pumps, lines, valves, regulators, and heat exchangers received attention. Selected designs of boost pumps to be mounted in the LH2 tanks, and of a high pressure pump to be mounted on the engine were defined. A final design of LH2-fueled transport aircraft was established which incorporates a preferred design of fuel system. That aircraft was then compared with a conventionally fueled counterpart designed to equivalent technology standards. Author

**N78-31086*#** Lockheed-California Co., Burbank.
**STUDY OF FUEL SYSTEMS FOR LH2-FUELED SUBSONIC TRANSPORT AIRCRAFT, VOLUME 2 Final Report, Sep. 1976 - Dec. 1977**
G. D. Brewer, R. E. Morris, G. W. Davis, E. F. Versaw, G. R. Cunnington, Jr. (Lockheed Missiles and Space Co., Inc.), J. C. Riple (AiResearch Mfg. Co.), C. F. Baerst (AiResearch Mfg. Co.), and G. Garmong (Rocketdyne) Jul. 1978 356 p refs 2 Vol.
(Contract NAS1-14614)
(NASA-CR-145369-Vol-2) Avail: NTIS HC A16/MF A01 CSCL 01C

For abstract, see N78-31085.

**N78-31087#** Royal Aircraft Establishment, Farnborough (England).
**TECHNICAL EVALUATION OF FLYING WEAPON SYSTEMS**
P. Ebeling Mar. 1978 28 p refs Transl. into ENGLISH of "Technische Bewertung Fliegender Waffensysteme", Rept. BMVg-FBWT-75-29-Pt-2 Fed. German Min. of Defense, West Germany, 1975 p 243-272
(RAE-Lib-Trans-1948; BR64083) Avail: NTIS HC A03/MF A01

Some details on the evaluation of military aircraft and missile weapon systems are presented. A technical evaluation of the different phases of weapon systems development and procurement is explained and a brief survey is given of the different methods involved. Two digital computer programs are detailed for design and scaling of aircraft and tactical missiles and their possible applications within the technical evaluation of weapon systems. G.G.

**N78-31088#** Lockheed-California Co., Burbank.
**GENERAL AVIATION AIRPLANE STRUCTURAL CRASHWORTHINESS USER'S MANUAL VOLUME 1: PROGRAM KRASH THEORY Final Report, Jun. 1976 - Feb. 1978**
Max A. Gamon Feb. 1978 278 p refs
(Contract DOT-FA75WA-3707)
(AD-A055898; LR-28307-Vol-1; FAA-RD-77-189-1-Vol-1) Avail: NTIS HC A13/MF A01 CSCL 01/2

A comprehensive description of program KRASH is provided. Included are the following sections: (1)Program KRASH; Description and Theory; and (2)Program Controls and Listing. B.B.

**N78-31089#** Boeing Vertol Co., Philadelphia, Pa.
**HELICOPTER TRANSMISSION VIBRATION AND NOISE REDUCTION PROGRAM. VOLUME 1: TECHNICAL REPORT Final Report, Jun. 1974 - Oct. 1977**
John J. Sciarra, Robert W. Howells, Joseph W. Lenski, Jr., Raymond J. Drago, and Edward G. Schaeffer Mar. 1978 307 p refs
(Contract DAAJ02-74-C-0040; DA Proj. 1G2-62207-AH-89) (AD-A055104; D210-11236-1; USARTL-TR-78-2A) Avail: NTIS HC A14/MF A01 CSCL 01/3

The objective of the Helicopter Transmission Vibration/Noise Reduction Program was to generate analytical tools for the prediction and reduction of helicopter transmission vibration/noise that provide the capability to perform trade studies during the design stage of a program. Application of this optimization capability yields drive train components that are dynamically quiet with reduced vibration/noise levels and inherently longer life. Author (GRA)

**N78-31090#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**AN EXTENDED KALMAN FILTER FIRE CONTROL SYSTEM AGAINST AIR-TO-AIR MISSILES, VOLUME 1 M.S. Thesis**
Salvatore J. Cusumano and Manuel DePonte, Jr. Dec. 1977 145 p refs
(AD-A055179; AFIT/GE/EE/77-13-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 19/5

A previously designed extended Kalman filter, based upon the proportional guidance law and an aerodynamic drag equation, is modified to include complete modeling of the autopilot and the guidance system of the missile. A sensitivity analysis of three key parameters is performed to determine the observability of these parameters and the possible need to estimate them in less complex filter models. This analysis establishes the advantages for reasonable estimates of all three parameters during a high-g trajectory. A less complex model reduces the number of filter states from eleven to eight. The seeker dynamics, the guidance system, and the autopilot of a missile are approximated by a first order lag. The three parameters estimated include the time

constant of the first order lag, the proportional navigation constant of the missile, and the ratio of mass to cross-sectional area of the missile. Under the high-g scenario, reasonably accurate estimates of the states and the parameters are accomplished. Under the low-g scenario, parameter estimates are degraded due to lack of excitation. This performance of the parameters, however, does not hinder the accurate estimation of the missile states. Author (GRA)

**N78-31091#** Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

**MODIFIED HELICOPTER ICING SPRAY SYSTEM EVALUATION Final Report, 23 Sep. - 4 Dec. 1975**

Gary L. Bender, Mathew S. Mathews, III, and John S. Tulloch Mar. 1977 87 p refs

(AD-A055039; USAAEFA-75-04) Avail: NTIS HC A05/MF A01 CSCL 01/3

All tests required 55 flight hours (41 flights). During the first testing period, structural and dynamic tests were conducted throughout the CH-47C flight envelope and the physical properties of the spray cloud generated by the modified icing spray system were measured. Two deficiencies were found: boom stresses greater than the materials endurance limit which severely restricted the maximum airspeed at which the system could be operated (110 knots true airspeed), and an inadequate and unsafe boom extension/retraction system. Additional modification was made to the system and envelope expansion tests were repeated. During the second testing period, the two deficiencies were eliminated. However, flight with the boom retracted (except at very low airspeeds) and flight at a rotor speed of 235 rpm continued to produce excessive boom stresses. These excessive stresses constituted a shortcoming. Additional modification to the HISS was made to correct this shortcoming. The modified HISS with this additional change is airworthy within the unrestricted CH-47C flight envelope. GRA

**N78-31092#** Army Agency for Aviation Safety, Fort Rucker, Ala.

**ANTITORQUE TRAINING: EVALUATION OF EFFECTIVENESS IN REDUCING MISHAP LOSSES**

William C. McDaniel Feb. 1978 19 p refs

(AD-A055040; USAAVS-TR-78-2) Avail: NTIS HC A02/MF A01 CSCL 05/9

This evaluation addressed the effectiveness of training for antitorque system malfunctions. An evaluation team composed of 11 analysts reviewed 121 mishaps meeting established criteria. Results indicated that emergency antitorque training was effective in those situations involving loss or impaired control of the antitorque system. In the case of emergency situations involving a loss of thrust or loss of component, present antitorque training appears to be less than adequate. The data supports continuation of emergency antitorque training. Results further imply that written procedures for coping with loss of thrust in the UH-1 and OH-58 should be reviewed for clarity and revised for ease of application. Further study shpuld be conducted to determine the optimal course of action to take in the event of antitorque failure or malfunction. Author (GRA)

**N78-31093#** Arinc Research Corp., Annapolis, Md.

**PROGRAM ANALYSES FOR THE S-3 WEAPON SYSTEM IMPROVEMENT PROGRAM Final Summary Report, 15 Sep. 1977 - 15 Jun. 1978**

W. Amos 15 Jun. 1978 20 p

(Contract N00019-77-C-0495)

(AD-A055887; Rept-1708-01-1-1762) Avail: NTIS HC A02/MF A01 CSCL 01/3

The overall objective of the program is to update major avionic and weapon subsystems of the S-3A to provide improvements and additional capabilities required to perform certain sea control mission elements during the late 1980s through the 1990s. GRA

**N78-31094#** Army Aviation Research and Development Command, St. Louis, Mo.

**COMPUTERIZED AIRCRAFT ATTRITION PROGRAM Final Report**

Ralph O. Tate May 1978 35 p refs

(AD-A055784; USAAVRADCOM-TR-78-9) Avail: NTIS HC A03/MF A01 CSCL 01/3

The Computerized Aircraft Attrition Program (THAAP) presented in this report provides for a rapid method of calculating the forecasted attrition to be experienced by a given homogenous fleet of aircraft over a specified period of time. The THAAP program is designed to be a time-saving tool which will provide the quantity of aircraft attrited and resultant flying hour program for the adjusted operational fleet. The program will provide for the time-phased induction and withdrawal of aircraft from the fleet over the operational life of the system. The information or output from the program is intended to be used as input to time-phased cost estimates, particularly operating and support cost estimates. The program's output is ideally suited for those studies which are performed manually or by computerized cost models which do not have a fleet attrition capability. Author (GRA)

**N78-31095#** Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

**CARGO AIRCRAFT AND SPACECRAFT FORWARD RESTRAINT CRITERIA Final Report, Jun. 1976 - Dec. 1977**

Joseph L. Weingarten Dec. 1977 91 p refs Revised

(AD-A055343; ASD-TR-76-30) Avail: NTIS HC A05/MF A01 CSCL 01/2

This investigation was primarily conducted to review probability projections of crashes of Air Force cargo aircraft as developed in 1971. The 1971 effort resulted in considerable changes to the air cargo operations. This included a lowering of restraint criteria to 3Gs with an auxiliary 9G net system. The objective of this effort was to determine if further reductions could be made through removal of the auxiliary 9G net, in addition to both aircraft and spacecraft cargo restraint criteria. Restraint and aircraft modifications were also examined. This effort viewed probabilities, based on the original data from January 1960 to July 1971, and an expanded base to July 1976 for a total of 40.4 million hours. Further, the original study viewed only major accidents; minor accidents have been added to this review. The probabilities developed in 1971 were conservative relative to actual occurrence over the past few years. Further, new probabilities were developed that show removal of the barrier net is feasible and appropriate changes are recommended to the current criteria. Commercial experience with barrier nets was also investigated and accidents where barriers were impacted are detailed. GRA

**N78-31096#** Mechanics Research, Inc., McLean, Va.

**DEMONSTRATION OF THE MICROWAVE ICE PROTECTION CONCEPT Final Report, Jun. 1976 - Jun. 1977**

Bertram Magenheim May 1978 127 p refs

(Contract DAAJ02-76-C-0052; DA Proj. 1L2-62209-AH-76)

(AD-A055824; USAAMRDL-TR-77-34) Avail: NTIS HC A07/MF A01 CSCL 01/3

An experimental demonstration of the microwave ice protection concept for helicopter rotor blades is presented. By shedding ice samples from experimental ice protection devices, microwave ice protection theory was verified. Increased power density in the ice layer is achieved by operating at higher microwave frequencies, resulting in significantly shorter shed times for the same microwave power. The microwave concept offers the possibility of constructing ice protection systems totally out of nonmetallic materials that will not deteriorate the radar cross section of composite blades. Incremental weight, cost and power estimates for equipping various helicopters are presented. An evolving microwave tube technology promises significant improvements in cost, efficiency, weight, and power drain while providing higher microwave powers and consequently shorter shed times. It is demonstrated that a combination erosion shield/surface waveguide constructed from ultrahigh molecular weight polyethylene (UHMWPE) fortified with a layer of polyurethane near the tip did not deteriorate the mean time between unscheduled maintenance (MTBUM) of the blade below that of the polyurethane erosion shield by itself. When the erosion shield/surface waveguide reaches the MTBUM it can be replaced without discarding the blade. Author (GRA)

**N78-31097#** Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

**A STUDY OF ANALOG PROGRAMMING FOR PREDICTION OF CRACK GROWTH IN AIRCRAFT STRUCTURES SUBJECTED TO RANDOM LOADS Final Report, Sep. 1976 - Jun. 1977**
Michael Weinreich, Richard F. Harris, Oscar Orringer, and John F. McCarthy, Jr. Jun. 1977 94 p refs
(Contract F33615-76-C-3109)
(AD-A055789; ASRL-TR-186-2; AFFDL-TR-77-58) Avail: NTIS HC A05/MF A01 CSCL 01/3

Results of a program to study an analog approach to risk analysis of random-load crack growth are presented. The two major objectives were to implement certain specific simulations of crack growth on hybrid analog/digital hardware, and to develop an improved approach to the modeling of random loads. Under the first objective, all but two of the specific simulations were implemented and verified. One not implemented required hardware unavailable at the installation utilized for the simulations. The other was identified as not conducive to analog simulation. These simulations utilized a 'damage parameter' (rather than crack size itself as the random variable) to provide well behaved and stable analog behavior. Under the second objective, a method of generating load statistics by direct inspection of large quantities of flight data was developed. In the course of this development, the applicability of estimation theory to the present problem was identified. The techniques of estimation theory, applied to analysis of damage in terms of an appropriately chosen damage parameter, promise to provide improved efficiency and accuracy in aircraft fatigue damage risk analysis. GRA

**N78-31098#** Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
**STATISTICAL REVIEW OF COUNTING ACCELEROMETER DATA FOR NAVY AND MARINE FLEET AIRCRAFT FROM 1 JANUARY 1962 TO 31 DECEMBER 1977 Semi-annual Summary Report, 1 Jan. 1962 - 31 Dec. 1977**
Alan M. Kaniss 1 May 1978 153 p
(AD-A055672; NADC-13920-2) Avail: NTIS HC A08/MF A01 CSCL 01/3

This report is a specialized summary of normal acceleration data recorded by counting accelerometers. Data are separated by calendar time and mission category. Only data reported in the counting accelerometer program are included. Author (GRA)

**N78-31099#** Sandia Labs., Livermore, Calif. Test Products Div. 8412.
**GRAPHICS FOR THE HYBRID STORES SEPARATION SIMULATION OF THE B77 SYSTEM**
R. G. Marmon Mar. 1978 43 p refs
(Contract EY-76-C-04-789)
(SAND-78-8212) Avail: NTIS HC A03/MF A01

The B77 is pictorially illustrated with the B52, F111, F4, and A7 aircraft in hybrid simulations. The design goals are covered and pictorial plots are given to verify the results. Actual flight test film is compared to a simulation with good results. ERA

**N78-31100#** RAND Corp., Santa Monica, Calif.
**ESTIMATED COSTS OF EXTENDED LOW-RATE AIRFRAME PRODUCTION Interim Report**
David J. Dreyfuss and Joseph P. Large Mar. 1978 69 p refs
(Contract F49620-77-C-0023)
(AD-A054834; RAND/R-2243-AF) Avail: NTIS HC A04/MF A01 CSCL 01/3

Achieving a high rate of production as quickly as possible has traditionally been viewed as the most effective way of satisfying time-urgent inventory requirements while keeping production costs low. One common consequence has been the delivery of less than fully qualified production articles. This report discusses the cost of extending initial low-rate production while tests of early production articles continue. The relatively small resultant cost increases can potentially be offset by the delivery of more capable production items, lessened needs for postdelivery modification or retrofit, and lower total-life system costs. Author (GRA)

# 06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

**N78-31101*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**SIMULATION AND FLIGHT EVALUATION OF A HEAD-UP LANDING AID FOR GENERAL AVIATION**
Randall L. Harris, Sr., Maxwell W. Goode, and Kenneth R. Yenni Sep. 1978 38 p refs
(NASA-TP-1276; L-12197) Avail: NTIS HC A03/MF A01 CSCL 01D

A head-up general aviation landing aid called a landing site indicator (LASI) was tested in a fixed-base, visual simulator and in an airplane to determine the effectiveness of the LASI. The display, which had a simplified format and method of implementation, presented to the pilot in his line of sight through the windshield a graphic representation of the airplane's velocity vector. In each testing model (simulation of flight), each of 4 pilots made 20 landing approaches with the LASI and 20 approaches without it. The standard deviations of approach and touchdown parameters were considered an indication of pilot consistency. Use of the LASI improved consistency and also reduced elevator, aileron, and rudder control activity. Pilots' comments indicated that the LASI reduced work load. An appendix is included with a discussion of the simulator effectiveness for visual flight tasks. Author

**N78-31102#** Research Triangle Inst., Research Triangle Park, N. C.
**AFAL SIMULATION FACILITY/CAPABILITY MANUAL VOLUME 1: EXECUTIVE SUMMARY AND SYSTEMS AVIONICS DIVISION Final Technical Report, Jul. 1976 - Jun. 1977**
Richard A. Whisnant, W. Howard Ruedger, Ronald L. Earp, and James Haidt Wright-Patterson AFB, Ohio AFAL 30 Jun. 1977 411 p refs
(Contract F33615-76-C-1308)
(AD-A055591; AFAL-TR-77-118-Vol-1) Avail: NTIS HC A18/MF A01 CSCL 01/3

The Air Force Avionics Laboratory (AFAL) at Wright-Patterson AFB is the focal point for development of new avionics technology for the Air Force. In order to carry out this responsibility, a significant capability to simulate physical avionics systems and components has been created by the AFAL divisions. Of prime concern is the effective use of these simulation facilities in the face of continually increasing performance requirements, technological advances and rising flight-test costs. GRA

# 07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

**N78-31103*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**GAS PATH SEAL Patent Application**
Robert C. Bill and Lawrence P. Ludwig, inventors (to NASA) Filed 4 Aug. 1978 9 p
(NASA-Case-Lew-12131-2; US-Patent-Appl-SN-931090) Avail: NTIS HC A02/MF A01 CSCL 21E

A gas path seal for a turbine engine or compressor is provided. The gas path seal comprises a shroud of material wearable or abradable relative to the material of the turbine or compressor blades and closely spaced from the blade tips. A compliant backing, preferably of several layers of corrugated metal or a compliant

material covered with a thin layer of ductile material, is provided about the shroud, and a rigid mounting surrounds the compliant backing. The novel feature is a compliant backing between the shroud and mounting. As a result normal forces during a blade rub are limited and wear is reduced and the life of the shroud is lengthened for a design of comparable clearance of blade to shroud. NASA

**N78-31104** Aeronautical Research Labs., Melbourne (Australia).
**A THEORETICAL STUDY OF THE PERFORMANCE OF A NUMBER OF DIFFERENT AXIAL-FLOW TURBINE CONFIGURATIONS UNDER CONDITIONS OF PULSATING FLOW**
Lincoln Erm Jul. 1977 55 p refs
(ARL-Mech-Eng-Rept-149; AR-000-734) Copyright. Avail: Issuing Activity

The best turbine configuration for operation with the pulsating flow occurring in a constant volume gas turbine was determined and described. The method of turbine performance prediction for steady flow operating conditions was developed for a single stage, axial flow turbine. During this development it was found that existing correlations for determining turbine loss characteristics at high negative angles of incidence were inadequate, and consequently, a modified approach was developed. Four basic two stage turbines, each having different blades angles, as well as several versions of one of these, were chosen for analysis. The mean efficiencies of these machines for pulsating flow operating conditions were estimated by using a quasi-steady method of analysis. The results obtained for the selected turbines are presented and compared with the results for the radial inflow turbine. A configuration is proposed that could possibly give better mean efficiencies under pulsating flow conditions than those actually considered. B.B.

**N78-31105*#** Naval Air Propulsion Test Center, Trenton, N.J.
**ROTOR BURST PROTECTION PROGRAM: STATISTICS ON AIRCRAFT GAS TURBINE ENGINE ROTOR FAILURES THAT OCCURRED IN US COMMERCIAL AVIATION DURING 1975 Final Report, 1974 - 1975**
R. A. DeLucia and G. J. Mangano May 1977 29 p
(NASA Order C-41581-B)
(NASA-CR-135304; NAPTC-PE-106) Avail: NTIS HC A03/MF A01 CSCL 21E

Statistics on gas turbine rotor failures that have occurred in U.S. commercial aviation during 1975 are presented. The compiled data were analyzed to establish: (1) The incidence of rotor failures and the number of contained and uncontained rotor bursts; (2) The distribution of rotor bursts with respect to engine rotor component; i.e., fan, compressor or turbine; (3) The type of rotor fragment (disk, rim or blade) typically generated at burst; (4) The cause of failure; (5) The type of engines involved; and (6) The flight condition at the time of failure. B.B.

**N78-31106*#** Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
**ADVANCED OPTICAL BLADE TIP CLEARANCE MEASUREMENT SYSTEM**
M. J. Ford, R. E. Honeycutt, R. E. Nordlund, and W. W. Robinson Jul. 1978 85 p refs
(Contract NAS3-20479)
(NASA-CR-159402; FR-10200A) Avail: NTIS HC A05/MF A01 CSCL 21E

An advanced electro-optical system was developed to measure single blade tip clearances and average blade tip clearances between a rotor and its gas path seal in an operating gas turbine engine. This system is applicable to fan, compressor, and turbine blade tip clearance measurement requirements, and the system probe is particularly suitable for operation in the extreme turbine environment. A study of optical properties of blade tips was conducted to establish measurement system application limitations. A series of laboratory tests was conducted to determine the measurement system's operational performance characteristics and to demonstrate system capability under simulated operating gas turbine environmental conditions. Operational and environmental performance test data are presented. Author

**N78-31107*#** Notre Dame Univ., Ind. Dept. of Electrical Engineering.
**ALTERNATIVES FOR JET ENGINE CONTROL Final Technical Report, 1 Mar. 1977 - 28 Feb. 1978**
R. J. Leake and M. K. Sain 28 Feb. 1978 233 p refs
(Grant NsG-3048)
(NASA-CR-157578) Avail: NTIS HC A11/MF A01 CSCL 21E

General goals of the research were classified into two categories. The first category involves the use of modern multivariable frequency domain methods for control of engine models in the neighborhood of a quiescent point. The second category involves the use of nonlinear modelling and optimization techniques for control of engine models over a more extensive part of the flight envelope. In the frequency domain category, works were published in the areas of low-interaction design, polynomial design, and multiple setpoint studies. A number of these ideas progressed to the point at which they are starting to attract practical interest. In the nonlinear category, advances were made both in engine modelling and in the details associated with software for determination of time optimal controls. Nonlinear models for a two spool turbofan engine were expanded and refined; and a promising new approach to automatic model generation was placed under study. A two time scale scheme was developed to do two-dimensional dynamic programming, and an outward spiral sweep technique has greatly speeded convergence times in time optimal calculations. F.O.S.

**N78-31108*#** General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
**ENERGY EFFICIENT ENGINE: PRELIMINARY DESIGN AND INTEGRATION STUDIES Final Report, Jan. 1977 - Apr. 1978**
R. P. Johnston, R. Hirschkron, C. C. Koch, R. E. Neitzel, and P. W. Vinson Sep. 1978 417 p refs
(Contract NAS3-20627)
(NASA-CR-135444; R78AEG510) Avail: NTIS HC A18/MF A01 CSCL 21E

Parametric design and mission evaluations of advanced turbofan configurations were conducted for future transport aircraft application. Economics, environmental suitability and fuel efficiency were investigated and compared with goals set by NASA. Of the candidate engines which included mixed- and separate-flow, direct-drive and geared configurations, an advanced mixed-flow direct-drive configuration was selected for further design and evaluation. All goals were judged to have been met except the acoustic goal. Also conducted was a performance risk analysis and a preliminary aerodynamic design of the 10 stage 23:1 pressure ratio compressor used in the study engines. Author

**N78-31109*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ANALYSIS OF METAL TEMPERATURE AND COOLANT FLOW WITH A THERMAL-BARRIER COATING ON A FULL-COVERAGE-FILM-COOLED TURBINE VANE**
Peter L. Meitner (AVRADCOM Res. and Technol. Labs.) Aug. 1978 15 p refs
(NASA-TP-1310; AVRADCOM-TR-78-20) Avail: NTIS HC A02/MF A01 CSCL 21E

The potential benefits of combining full-coverage film cooling with a thermal-barrier coating were investigated analytically for sections on the suction and pressure sides a high-temperature, high-pressure turbine vane. Metal and ceramic coating temperatures were calculated as a function of coating thickness and coolant flow. With a thermal-barrier coating, the coolant flows required for the chosen sections were half those of an uncoated design, and the metal outer temperatures were simultaneously reduced by over 111 K (200 F). For comparison, transpiration cooling was also investigated. Full-coverage film cooling of a coated vane required more coolant flow than did transpiration cooling. Author

**N78-31110#** Army Research and Technology Labs., Fort Eustis, Va.
**HEAT TRANSFER MODELING AND ANALYTICAL QUENCHING OF A POWDER METALLURGY TURBINE DISK DURING HEAT TREATMENT Final Report**
Jan M. Lane Mar. 1978 53 p refs
(AD-A054022; USARTL-TR-78-6) Avail: NTIS HC A04/MF A01 CSCL 21/5

A conduction heat transfer analysis was used to model experimental internal metal temperatures measured by thermocouples imbedded in superalloy turbine task disk 'blanks' of varying thickness while they were quenched during heat treatment in several media, including oil, salt, and air. The computer model deduced effective values of the average surface heat transfer coefficient as the superalloy part cooled from the solution temperature during heat treatment. The resulting heat transfer coefficients were applied to actual Hot Isostatically Pressed (As-HIP) turbine disk shapes (target sonic) by a modified computer analysis to determine local cooling rates and cooling rate variations within the quenched disks. An assessment was made of the expected variation in tensile properties that would be created in the disk due to heat transfer and geometrical shape tests.

Author (GRA)

**N78-31111#** Mechanical Technology, Inc., Latham, N. Y.
**TURBINE ENGINE ROTORDYNAMIC EVALUATION, VOLUME 1 Final Report, 1 May 1975 - 1 Jun. 1976**
R. A. Rio Wright-Patterson AFB, Ohio AFAPL Jan. 1978 218 p
(Contract F33615-75-C-2035; AF Proj. 3066)
(AD-A055262; MTI-76TR41-Vol-1; AFAPL-TR-76-81-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 21/5

Eight jet engine models within the Air Force inventory (the T56, J57, J79, J85, TF30, TF33, TF39 and TF41) have been analyzed to determine critical speeds, unbalance response, blade loss effects and maneuver deflections. The effects of dampers, thrust loads and balancing requirements, while not analyzed in depth, were noted where applicable in the description of the engine's dynamic behavior. Each rotor design was then classified into categories of dynamic sensitivity. Five test elements were manufactured and vibrated to obtain experimental data for correlation with analytical modeling predictions. The four cylindrical elements, each of which incorporated either a steep cone, shallow cone, flat plate or thin shell, were excited to obtain the first three lateral natural frequencies. Because of manufacturing problems with hardness and weld penetration, measured frequencies were below those predicted. The fifth test element was a machined flexible bearing support for use in parallel with a squeeze film damper. After static and dynamic testing of this representative flexible bearing support, the results were within 10% of the analytical prediction for this element. The information from this analytical and experimental study has resulted in a technology plan whose goal is to improve the technological capabilities for the purpose of reducing costs associated with reliability and maintainability of U.S. Air Force engines.

Author (GRA)

**N78-31112#** Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
**GROUND IMPINGEMENT OF A FAN JET EXHAUST PLUME**
William G. Hill, Jr. and Richard C. Jenkins May 1978 52 p refs
(AD-A054832; RM-653) Avail: NTIS HC A04/MF A01 CSCL 21/2

This report describes an investigation of the ground impingement properties of a fan jet engine exhaust. Measurements were taken using both a simulated fan jet of laboratory scale and a large scale operating fan jet engine. The results of this work will be used to modify existing models of exhaust-ground interactions to include the unique properties of fan jet impingement on the flow field under a hovering VTOL aircraft, with particular application to the Grumman Design 698. The simulated fan jet exhaust was produced by cold air issuing from a concentric nozzle and utilizing a screen in the inner section to develop the lower dynamic pressure that is characteristic of a real fan jet engine. Measurements taken during impingement of the jet engine exhaust consisted of pitot pressure profiles above the ground. Wall jet velocity profiles obtained in these two impingement flows showed close agreement when scaled by size and nozzle pressure ratio. This favorable comparison demonstrates the effectiveness of using cold air, scale model flows to simulate the impingement flow field of a real fan jet engine exhaust. The effects on the impingement flow of an immersed control vane were investigated in both the simulated and the fan jet engine exhausts.

Author (GRA)

**N78-31113#** Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
**RADIOGRAPHIC EXAMINATION OF T55 ENGINE Final Report, Apr. 1977 - Jan. 1978**
John T. Carroll Jan. 1978 24 p refs
(Contract DAAJ01-77-C-0354)
(AD-A055108; FR-9560; USAAVRADCOM-CH47-M-78-01) Avail: NTIS HC A02/MF A01 CSCL 21/5

Approximately 1000 radiographs and three hours of video fluoroscope tapes of a Lycoming T55-L-712 turbine engine were obtained at various engine operating conditions. These X-ray images were needed to determine certain static and running clearances in the T55 engine.

Author (GRA)

**N78-31114#** Boeing Vertol Co., Philadelphia, Pa.
**ENGINE/AIRFRAME/DRIVE TRAIN DYNAMIC INTERFACE DOCUMENTATION Final Report**
D. A. Richardson and J. R. Alwang Apr. 1978 209 p refs
(Contract DAAJ02-77-C-0040)
(AD-A055766; D210-11328-1; USARTL-TR-78-11) Avail: NTIS HC A10/MF A01 CSCL 21/5

Engine/airframe/drive train dynamic interface problems of Boeing helicopters are described. The investigation leading to the problem solution, the solution, and its limitations are discussed. Forecasts of potential future problems, recommendation for investigations, and specifications are included.

Author (GRA)

**N78-31115#** General Electric Co., Lynn, Mass. Aircraft Engine Group.
**TURBINE TIP CLEARANCE MEASUREMENT Final Report, Jun. 1975 - Oct. 1977**
Lawrence C. Baker, Gordon E. Grady, and Hagen R. Mauch Mar. 1978 179 p refs
(Contract DAAJ02-75-C-0046)
(AD-A055765; R78AEG017; USARTL-TR-78-4) Avail: NTIS HC A09/MF A01 CSCL 21/5

Turbine tip clearance design and prediction techniques have been limited to analytical methods for lack of an accurate direct measurement device. It was the purpose of this program to substantiate prediction correlations utilizing direct measurements from a laser-powered miniaturized turbine tip clearance device (MTCMD) previously developed under Applied Technology Laboratory support. The resultant comparisons of measured versus analytically determined clearances based on measured temperatures would be used to verify or to improve the analytical techniques.

GRA

**N78-31116#** General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
**BACKUP CONTROL FOR A VARIABLE CYCLE ENGINE Interim Technical Report, Aug. 1976 - Aug. 1977**
Howard B. Kast, Garry L. Poppel, and James E. Hurtle Dec. 1977 201 p refs
(Contract F33615-76-C-2086)
(AD-A055658; AFAPL-TR-77-92; Doc-77AEG633) Avail: NTIS HC A10/MF A01 CSCL 21/5

This report documents the results of Phase 1, the trade studies, of the Backup Control for a Variable Cycle Engine program. The trade studies were based on a single engine aircraft, the JTDE-23 engine and a full authority digital electronic primary control system. A minimum 'get home' capability was defined which included completing a takeoff, a minimum climb rate, deceleration from supersonic flight, windmill air start, minimum cruise range, wave-off, landing and safe runway roll. Backup control requirements were determined using the YF17 aircraft data for thrust, the JTDE-23 engine computer model for the variables to be controlled, and the F101 engine and control model for transient performance. Seven backup control approaches were selected for consideration from a list of 48 possibilities. These approaches included hydromechanical, electrical, fluidic and a combination of electrical/hydromechanical technologies. Reliability estimates were made on six controls and estimated performance, volume, weight, cost analyses and preliminary design. Studies were made in more detail on three of these approaches. A recommended approach was selected; namely, the hydromechanical backup control using speed demand and fuel flow scheduling. This selection was based on the above analyses and studies, together with a comparison of the

technologies, a comparison of parallel versus series type backup/primary control interface and a tabulated evaluation of each backup control's advantages and disadvantages. GRA

**N78-31117#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Flugkoerperantriebe.

**FLAME STABILIZATION IN A RAMJET COMBUSTION CHAMBER BY MEANS OF A PILOT GAS GENERATOR**

Egbert Riester 16 Dec. 1977 54 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-511)

(DLR-FB-77-54) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 28,20

Flame stabilization in ramjet combustors being difficult because of the high combustion chamber entrance velocity and the low temperature, the shifting of the flame out limit towards lower equivalent ratios by use of a pilot gas generator was investigated. The velocity distributions are determined in a typical arrangement of a ramjet combustor. The flame-out limit was measured, at first without, afterwards with a pilot gas generator. The results were compared with each other. As pilot gas generator a small stoichiometrical propane-oxygen-burner was used. Author (ESA)

**N78-31118#** Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

**ANALYSIS OF MULTISTAGE, AXIAL FLOW TURBOMACHINE WAKE PRODUCTION, TRANSPORT, AND INTERACTION Interim Report, 1 Oct. 1976 - 30 Sep. 1977**

J. H. Wagner and T. H. Okiishi Dec. 1977 113 p refs

(Grant AF-AFOSR-2916-76)

(AD-A055754; ISU-ERI-AMES-78173; TCRL-10; AFOSR-78-1028TR) Avail: NTIS HC A06/MF A01 CSCL 20/4

A periodic-average flow measurement technique involving a hot-wire anemometer system was used to measure the periodically unsteady and three-dimensional fluid velocity field between blade rows in the first stage of a low-speed, multistage, axial-flow research compressor. These data suggest that the fluid flow through the imbedded rotor and stator rows is appreciably unsteady, in a periodic fashion in portions of the compressor annulus. Illustrative examples of periodic-average fluid flow field variation with rotor blade sampling position in stop-action sequence are presented for different locations in the compressor. A simple, first order approximation physical description of the blade wake flow transport and interaction process largely based on experimental data interpretation is proposed to organize and to help explain the obsdrvations made. Blade span variations of flow data reflect end-wall effects. Inlet guide vane exit flow data involve some unusual unsteady flow effects. Author (GRA)

## 08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

**N78-31119#** Hughes Helicopters, Culver City, Calif.

**EVALUATION OF A CIRCULATION CONTROL TAIL BOOM FOR YAW CONTROL Final Report, 1 Mar. 1977 - 1 Feb. 1978**

A. H. Logan Apr. 1978 52 p refs

(Contract DAAJ02-77-C-0018)

(AD-A055116; HH-77-307; USARTL-TR-78-10) Avail: NTIS HC A04/MF A01 CSCL 01/3

An experimental tail boom which uses circulation control principles to produce antitorque force from the main rotor downwash was flight-tested over a typical flight regime. The flight envelope included hover; sideward and rearward flight to 30 knots; forward flight to 80 knots; climbs, turns, and maneuvers, such as pull-ups, and push-overs at 60 knots; and autorotation. GRA

**N78-31120#** Applied Devices Corp., Kissimmee, Fla.

**A MODULAR ADAPTIVE, VARIABLE FUNCTION FLIGHT CONTROL SENSOR Final Report, Mar. 1975 - Feb. 1977**

Roland Pittman Oct. 1977 80 p refs

(Contract F33615-75-C-3154)

(AD-A055175; AFFDL-TR-77-112) Avail: NTIS HC A05/MF A01 CSCL 01/4

This development effort culminated in flight-worthy test articles of multi-function sensors, for use in 'strap-down' flight control systems. The multi-function sensor with one moving part, performs the equivalent to a two-axis rate gyro, two-axis linear accelerometer, a three-axis magnetic field sensor, a two-axis electric field sensor, and a two-axis air data probe. This development effort demonstrated the feasibility of a multi-function sensor which brings together the elements of a multi-mode flight control sensing scheme' that is, one which takes a measure of the earth's electric and magnetic fields, the air mass through which the carrying vehicle is moving, and a measure of vehicle angular velocity and linear acceleration. Its use is intended to determine vehicle heading, velocity, and attitude with respect to the magnetic north, air mass flow and local vertical. The aim of the effort was to reduce cost, power consumption, volume and mechanical complexity by an order of magnitude. GRA

**N78-31121#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**THE TERRAIN FOLLOWING TASK FOR THE ADVANCED TACTICAL FIGHTER USING DISCRETE OPTIMAL CONTROL M.S. Thesis**

Ross Leon Simmons Dec. 1977 110 p refs

(AD-A055196; AFIT/GE/EE/77-39) Avail: NTIS HC A06/MF A01 CSCL 01/3

Through the use of state space, continuous optimal control, and discrete optimal control, a digital flight control system was designed for the terrain following task. After formulating the aircraft linear perturbation model, the deterministic regulator problem was solved with a quadratic performance index to provide the desired continuous closed loop system. The system and performance index were then discretized to form a discrete deterministic regulator problem. This discrete regulator problem was then solved as a function of sample rate using eigenvector decomposition to determine a minimum acceptable rate for sampling. The effects of sample rate on the system were then examined. A sample rate of five hertz was shown to be high enough to adequately form the desired controls. A reference command generator based on constant energy path legs was developed to provide the required reference states and control inputs. The reference terrain following path was generated by an optimal cubic spline algorithm. The aircraft was shown to track the desired path in a highly acceptable manner through the use of a hybrid simulation. The design method utilized is recommended for consideration in designing the digital flight control system for other flight control tasks. Author (GRA)

**N78-31122#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**OPTIMAL TERRAIN FOLLOWING CONTROLLER FOR AN OPTIMIZED SPLINE REFERENCE PATH M.S. Thesis**

Ronald T. Kelly Dec. 1977 136 p refs

(AD-A055234; AFIT/GA/EE/77-3) Avail: NTIS HC A07/MF A01 CSCL 01/3

This thesis presents the design of a proposed terrain following flight controller capable of tracking a cubic spline reference path. The controller tracks only the longitudinal motion; however, it provides both thrust and elevator control. The controller is based on a nonlinear reference model constructed from an optimized spline path. The spline path altitude and associated derivatives are computed. The longitudinal equations of motion are linearized about the reference trajectory and a truth model of actual aircraft motion is developed. Deviations from the nonlinear reference trajectory to the actual provide a linear system. Optimal control theory is used to solve the resulting linear regulator problem. The feedback gains are calculated from the steady-state Ricatti matrix equation. The two system controls are updated using these feedback gains. Results show the feedback controller to be stable and capable of tracking the cubic spline reference path. The performance index weighting matrices can be adjusted to improve the controller. The resulting controller can provide

both good path control and engine control to improve vehicle survivability, engine life and fuel consumption. Author (GRA)

**N78-31123#** Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
**THE INFLUENCE OF THROTTLE AUGMENTED STABILITY (APCS) AND SHORT PERIOD CONTROL CHARACTERISTICS ON THE LANDING APPROACH Final Technical Report, Jul. 1975 - Jun. 1976**
George E. Miller, Shigeo Sembongi, and Edward Seckel Mar. 1978 182 p refs
(Contract N00019-75-C-0528)
(AD-A055892; AMS-1325) Avail: NTIS HC A09/MF A01 CSCL 01/2

The results of an analysis and flight test research program sponsored by the Naval Air Systems Command are presented. The equivalence between Approach Power Compensator System (APCS) feedbacks and aircraft stability derivatives is shown, and expressions relating these terms to system decoupling are developed in the analysis. Attitude command, washout prefilter, and conventional flight control systems are compared in ground and flight tests. Pseudo-velocity-type APCS configurations were found to provide better flight path control than predominantly angle of attack type APCS configurations for the carrier approach task. For typical levels of aircraft static stability, increasing the short period frequency through a simple pitch attitude command flight control system improved the flight path response.
Author (GRA)

**N78-31124#** Missouri Univ. - Columbia. Dept. of Electrical Engineering.
**INHERENT ERRORS IN ASYNCHRONOUS DIGITAL FLIGHT CONTROLS Annual Technical Report, 1 Feb. 1977 - 31 Jan. 1978**
Charles Slivinsky 31 Mar. 1978 254 p refs
(Grant AF-AFOSR-2968-76)
(AD-A055649; AFOSR-78-1054TR) Avail: NTIS HC A12/MF A01 CSCL 01/4

This report describes research on redundancy management in digital flight control systems. The emphasis is on the properties, techniques, and requirements associated with the operations of monitoring and voting and their effects on the closed loop system operation when asynchronous sampling is used. Part 1 is concerned primarily with the monitoring operation for quadredundant input signals. Part 2 presents three extensions to a previously reported model for closed loop flight control systems that have dual-redundant, asynchronous digital controllers. GRA

**N78-31125#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abt. Regelungssysteme.
**CONTROL SYSTEM DESIGN USING VECTOR-VALUED PERFORMANCE CRITERIA WITH APPLICATION TO THE CONTROL RATE REDUCTION IN PARAMETER INSENSITIVE CONTROL SYSTEMS**
Gerhard Kreisselmeier 20 Dec. 1977 36 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-512)
(DLR-FB-77-55) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 17

For a realistic flight control problem it is shown, that a vector performance criterion is a natural and meaningful criterion for the judgement and the design of a control system. For the controller design then a strategy is suggested, which includes the vector-valued performance criterion in the optimization of the control system, such that a systematic step by step improvement of the performance vector is achieved, i.e. improvement of certain of its components without undesirable deterioration of the remaining components, which finally yields the best possible controller design. This technique is applied to the design of a parameter insensitive flight path controller, which shows a larger sensitivity reduction than obtained previously while a considerable reduction of the maximal control rate is achieved. This controller is the first to prove, that a considerable sensitivity reduction can be possible without increasing the requirements of the actuator system. These results are primarily due to the direct consideration of the control rate in the design.
Author (ESA)

**N78-31126#** Advisory Group for Aerospace Research and Development, Paris (France).
**CONSIDERATIONS ON WING STORES FLUTTER: ASYMMETRY, FLUTTER SUPPRESSION**
Jul. 1978 42 p Presented at the 46th Struct. and Mater. Panel Meeting, Aalborg, Denmark, 10-14 Apr. 1978
(AGARD-R-668; ISBN-92-835-1290-1) Avail: NTIS HC A03/MF A01

The problems pertaining to aeroelasticity and flutter of aircraft wing stores are explained and solutions are suggested. For individual titles, see N78-31127 through N78-31128.

**N78-31127#** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
**ASYMMETRIC STORE FLUTTER**
A. Lotze *In* AGARD Considerations on Wing Stores Flutter Jul. 1978 p 1-19 refs (For primary document see N78-31126 22-08)
Avail: NTIS HC A03/MF A01

A large number of asymmetrical store configurations were investigated by analysis and wind tunnel testing, to establish the physical background for the flutter mechanism of asymmetrical stores and to find out whether unfavorable effects of asymmetries exist only for mild flutter or could also occur for flutter cases exhibiting large gradients of aerodynamic damping with airspeed. Based on the results it is recommended to establish flutter trends by variation of important parameters before actual store configurations are calculated. Once the regions with possible lower flutter speeds of asymmetrical stores are defined, those configurations can be selected which have to be investigated.
L.S.

**N78-31128*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**DEMONSTRATION OF AIRCRAFT WING/STORE FLUTTER SUPPRESSION SYSTEMS**
Chintsun Hwang (Northrop Corp., Hawthorne, Calif.), Bertil A. Winther (Northrop Corp., Hawthorne, Calif.), Thomas E. Noll (AFFDL, Wright-Patterson AFB, Ohio), and Moses G. Farmer *In* AGARD Considerations on Wing Stores Flutter Jul. 1978 p 21-37 refs (For primary document see N78-31126 22-08)
Avail: NTIS HC A03/MF A01

Preliminary results are presented of the design analysis and the test progress of active wing/store flutter suppression systems on a lightweight fighter aircraft. Three configurations were selected for final testing. Two of these configurations were deliberately designed to exhibit low flutter speeds with rapid reduction in damping at the incipient flutter condition. After initial tunnel entries, which showed the need for certain improvements in the model and the control system design, substantial increases in the flutter speeds were achieved using both leading and trailing edge control surfaces separately. For the most critical configuration, a demonstrated improvement of 18% and a projected improvement of 29% in the dynamic pressure were accomplished.
L.S.

# 09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

**N78-31129*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**MULTI-PURPOSE WIND TUNNEL REACTION CONTROL MODEL BLOCK Patent**
Henry S. Dresser (Rockwell Intern. Corp., Downey, Calif.) and Joseph J. Daileda, inventors (to NASA) (Rockwell Intern. Corp., Downey, Calif.) Issued 30 May 1978 6 p Filed 11 Feb. 1977 Supersedes N77-19077 (15 - 10, p 1226) Sponsored by NASA
(NASA-Case-MSC-19706-1; US-Patent-4,091,665;

US-Patent-Appl-SN-767911; US-Patent-Class-73-147; US-Patent-Class-239-265.25) Avail: US Patent Office CSCL 14B

A reaction control system nozzle block is provided for testing the response characteristics of space vehicles to a variety of reaction control thruster configurations. A pressurized air system is connected with the supply lines which lead to the individual jet nozzles. Each supply line terminates in a compact cylindrical plenum volume, axially perpendicular and adjacent to the throat of the jet nozzle. The volume of the cylindrical plenum is sized to provide uniform thrust characteristics from each jet nozzle irrespective of the angle of approach of the supply line to the plenum. Each supply line may be plugged or capped to stop the air supply to selected jet nozzles, thereby enabling a variety of nozzle configurations to be obtained from a single model nozzle block. Official Gazette of the U.S. Patent Office

**N78-31130#** Mitre Corp., McLean, Va. Metrek Div.
**PARAMETERS OF FUTURE ATC SYSTEMS RELATING TO AIRPORT CAPACITY/DELAY Final Report**
Andrew L. Haines Apr. 1978 25 p refs
(Contract DOT-FA78WA-4075)
(AD-A055482; MTR-7766; FAA-EM-78-8) Avail: NTIS HC A02/MF A01 CSCL 01/5

Estimates of changes in longitudinal spacing on final approach that may be realized as the products of the engineering and development programs become available are presented. The potential for reducing interarrival errors and runway occupancy time is also discussed. The parametric values presented are to be used by the FAA/User Group Airport Case Study Teams in assessing the potential impact of future airport changes on delay/capacity. Parameter values related to the estimation of present day delay/capacity are also presented. S.B.S.

**N78-31131#** Mitre Corp., McLean, Va. Metrek Div.
**ANALYSIS OF RUNWAY OCCUPANCY TIMES AT MAJOR AIRPORTS Final Report**
Steven E. Koenig May 1978 56 p refs
(Contract DOT-FA78WA-4075)
(AD-A056052; MTR-7837; FAA-EM-78-9) Avail: NTIS HC A04/MF A01 CSCL 01/5

Future airport capacity is greatly dependent on the levels to which interarrival spacings can be reduced. Specific causes of longer runway occupancy times today are identified as they relate to airline, exit, aircraft, runway, and airport. Identified are potential, short-term improvements that might be expected at particular runways given an appropriately motivated environment. G.G.

**N78-31132#** National Aviation Facilities Experimental Center, Atlantic City, N. J.
**DULLES CONTROL TOWER CONSOLE DESIGN STUDY Final Report, May 1977 - May 1978**
J. Roy Bradley, Jr. Jun. 1978 46 p refs
(AD-A056200; FAA-NA-78-30; FAA-RD-78-69) Avail: NTIS HC A03/MF A01 CSCL 01/5

The development and testing effort directed toward providing a plan for inservice improvements to the operational quarters of Dulles International Airport Control Tower is described. Through the use of full-scale mockups, console designs and equipment arrangements were established, modified, and appraised. Opinions and recommendations of Air personnel from Dulles Tower were used as a basis for determining the advantages or disadvantages of particular equipments and their locations, console designs, and modifications. A proposal for refurbishing the operation's quarters of Dulles Tower is included along with drawings for a new console and a plan for an improved position and equipment arrangement. A.R.H.

**N78-31133#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**SOFTWARE DESIGN FOR A VISUALLY-COUPLED AIRBORNE SYSTEMS SIMULATOR (VCASS) M.S. Thesis**
William H. Reeve and Jerry L. Stinson Mar. 1978 215 p refs
(AD-A055226; AFIT/GCS/EE/78-6) Avail: NTIS HC A10/MF A01 CSCL 01/4

This thesis contains an analysis of a Visually Coupled Airborne Systems Simulator (VCASS) and the design of the software for this system. The design is developed in three steps. First, an informal requirements definition is written to establish the viewpoint and the purpose on which the analyst bases his design. This requirements definition explains why the simulator is to be created and what it is to do. Second, a top-down strategy called 'structured analysis' is applied to obtain a formal requirements definition. The structured analysis is presented in a blueprint-type language consisting of activity and data models. These models represent graphically the functions performed by the simulator and the information upon which those functions act. Third, a design is obtained through a structured design methodology consisting of 'transform analysis' and 'transaction analysis' techniques. The structure charts drawn during the analysis phase reveal system characteristics which illustrate design quality. The activity model is used to make a successful transition from a top-down analysis to a structured design which can be evaluated. The resulting simulator design, with minor revisions, satisfies the design goals established for the project. The methodologies used are highly recommended for the analysis and design of any software system. Author (GRA)

**N78-31134#** Arinc Research Corp., Annapolis, Md.
**EXPERIMENTAL TEST PLAN FOR THE EVALUATION OF AIRCRAFT SEPARATION ASSURANCE DISPLAYS USING AIRLINE FLIGHT SIMULATORS**
Thomas Berry Jun. 1978 68 p
(Contract DOT-FA78WA-4091)
(AD-A055849; Rept-1343-01-1-1753) Avail: NTIS HC A04/MF A01 CSCL 01/3

This test plan describes an experiment for evaluating the cockpit impact of the use of Aircraft Separation Assurance information using a jet transport aircraft simulator and operational airline flight crews. Three concepts for displaying ASA information will be utilized during the evaluation; six flight scenarios, each with a set of six flight conflicts, will be used. Figures of merit for evaluating the display concepts include response delay times, achieved miss distances, deviation from desired flight path, achieved acceleration rates, and qualitative crew opinions. Author (GRA)

**N78-31135#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastik.
**INVESTIGATIONS ON UNSTEADY PRESSURE DISTRIBUTION MEASUREMENTS IN ROTATING SYSTEMS**
Karl Kienappel 5 Oct. 1977 47 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-503)
(DLR-FB-77-43) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 23,80

The theoretical basic requirements to measure unsteady periodic pressure distributions in a rotating system are discussed. An experimental test setup to investigate the problems of the measurement technology is described. First results of this experiment made in a 3 m windtunnel are presented. It is concluded that the indirect measurement method used is suitable to establish unsteady nonharmonic pressure distributions in rotating systems. Author (ESA)

# 12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

**N78-31136** Purdue Univ., Lafayette, Ind.
**A MONTE CARLO ANALYSIS OF SCIENCE INSTRUMENT SCAN SEQUENCES FOR UNMANNED MISSIONS TO THE PLANETS Ph.D. Thesis**
Richard Earl VanAllen 1977 276 p
Avail: Univ. Microfilms Order No. 78-13133

The sensitivities of information returned for variations in sample size, the number of segments into which the target was divided, trajectory errors, and spacdcraft errors were examined. It was found that for mosaics nominally designed to cover the entire planet or satellite, 100 samples and 81 segments yielded sufficient accurate statistical results for preliminary analysis

purposes. For mosaics nominally designed to cover only part of a body, each must be treated individually, although the above combination would be a good starting point. Statistical result were compared with actual flight results for a representative mosaic from the 1973 Mariner Venus/Mercury mission. The software predicted that for the representative flight mosaic analyzed, there was a 99 percent probability of losing at least 10 percent of the desired area of interest. Approximatdly 10 percent of the desired area was in fact lostj Dissert. Abstr.

**N78-31137#** Committee on Science and Technology (U. S. House).
**INTERNATIONAL SPACE ACTIVITIES**
Washington GPO 1978 350 p refs Hearings before Subcomm. on Space Sci. and Applications of the Comm. on Sci. and Technol., 95th Congr., 2d Sess., 16-18 May 1978
(GPO-30-920) Avail: Subcomm. on Space Sci. and Applications

The hearings on international space programs are reported. The space policy of France as a member of the European Space Agency is discussed along the Franco-Soviet cooperation. The peaceful use of space programs, and the spacd research and development in Japan are discussed. F.O.S.

**N78-31138#** British Aircraft Corp. (Operating) Ltd., Bristol (England). Electronics and Space Systems Group.
**DEFINITION STUDY OF A MULTIDISCIPLINARY EUROPEAN MISSION. VOLUME 1: EXECUTIVE SUMMARY ESA Spacelab Utilization Program. Final Report**
Paris ESA Oct. 1977 70 p
(Contract ESTEC-3202/77)
(ESS/SS-777; ESA-CR(P)-1078) Avail: NTIS HC A25/MF A01

The feasibility of combining major experiment instruments with smaller ones (Add-ons) to produce multidisciplinary Spacelab mission payloads suitable for flight within one or two years of the First Spacelab Payload (FSLP) was studied. Some thirteen payload options covering five Spacelab configurations were identified and from these two payloads were carried forward for detail analysis. Both short module plus three pallet configurations, they relate to atmospheric physics and astronomy disciplines. The payloads were evolved to maximize scientific return within Spacelab and orbiter constraints and the payload specialist, power, energy and data assembly, integration and test programs of these model payloads were drawn up against a one year post FSLP flight date. This formed the basis for the assessment of mission dependent costs for the atmospheric physics fayload. The feasibility of creating related discipline payloads was established and the typical problems associated with their realization analyzed. Author (ESA)

**N78-32013*#** National Aeronautics and Space Administration, Washington, D. C.
**THE GAMMA RAY OBSERVATORY**
Albert G. Opp *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 575-576 (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 22A

# 13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

**N78-31139** California Univ., Los Angeles.
**OPTIMIZATION AND ESTIMATION IN NONLINEAR SYSTEMS WITH APPLICATION TO INERTIAL GUIDANCE Ph.D. Thesis**
James Warren Austin 1978 163 p
Avail: Univ. Microfilms Order No. 78-13939

In the application of optimal control theory to practical problems, one difficulty which arises is that the resulting control laws are difficult or expensive to mechanize. This problem is formulated as a problem in the calculus of variations. This results in an explicit minimization of a terminal error performance index for a nonlinear system. This takes the form of a two point boundary value problem. These results are applied to an inertial guidance problem and a numerical solution obtained by a modification of the gradient method. Estimation or filtering in the context of a nonlinear problem, viz., estimation of the state of an inertially guided reentry vehicle is examined. It is demonstrated by numerical example that a linearized filter based on statistical optimization performs much better than the extended Kalman filter in this application. Dissert. Abstr.

# 14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

**N78-32008*#** Maryland Univ., College Park.
**GAMMA RAY FACILITIES AT THE UNIVERSITY OF MARYLAND CYCLOTRON**
W. F. Hornyak *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 512-514 refs Sponsored in part by NSF (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 14B

# 15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

**N78-31140*#** Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
**DESIGN DEFINITION STUDY OF THE EARTH RADIATION BUDGET SATELLITE SYSTEM Final Report**
T. H. VonderHaar and W. H. Wallschlaeger (Ball Aerospace Systems Div.) Aug. 1978 145 p
(Contract NAS1-14538)
(NASA-CR-158934) Avail: NTIS HC A07/MF A01 CSCL 22B

Instruments for measuring the radiation budget components are discussed, and the conceptual design of instruments for the Earth Radiation Budget Satellite System (ERBSS) are reported. Scanning and nonscanning assemblies are described. The ERBSS test program is also described. F.O.S.

**N78-31141*#** Dayton Univ., Ohio. Research Inst.
**CONTINUATION OF THE COMPENDIUM OF APPLICATIONS TECHNOLOGY SATELLITE AND COMMUNICATIONS TECHNOLOGY SATELLITE USER EXPERIMENTS 1967-1977, VOLUME 1 Final Report**
Nicholas A. Engler, John F. Nash, and Jerry D. Strange May 1978 203 p refs
(Contract NAS3-20392)
(NASA-CR-135416-Vol-1; UDR-TR-78-67-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 22A

User experiments conducted utilizing the Applications Technology Satellites (ATS) 1, 3, 5, and 6 and the Communications Technology Satellite are summarized. The experiments are grouped by type of service offered. For example: education, health services, and data transmission. Particular emphasis is given to summarizing and evaluating user attitudes toward the ATS program. J.M.S.

**N78-31142*#** Dayton Univ., Ohio. Research Inst.
**CONTINUATION OF THE COMPENDIUM OF APPLICATIONS TECHNOLOGY SATELLITE AND COMMUNICATIONS TECHNOLOGY SATELLITE USER EXPERIMENTS 1967-1977, VOLUME 2 Final Report**
Nicholas A. Engler, John F. Nash, and Jerry D. Strange May 1978 455 p refs
(Contract NAS3-20392)

(NASA-CR-135416-Vol-2; UDR-TR-78-67-Vol-2) Avail: NTIS HC A20/MF A01 CSCL 22A

Approximately 453 reports, papers, and articles catalogued into an information retrieval system, covering communications experiments and demonstrations conducted, utilizing the Communications Technology Satellite and the Applications Technology Satellites 1, 3, 5, and 6 are listed. J.M.S.

**N78-31143*#** Raytheon Co., Wayland, Mass. Microwave and Power Tube Div.

**DESIGN, FABRICATION AND TESTING OF A CFA FOR USE IN THE SOLAR POWER SATELLITE Final Report**

William C. Brown Aug. 1978 152 p refs

(Contract NAS3-20374)

(NASA-CR-159410; PT-5228) Avail: NTIS HC A08/MF A01 CSCL 22B

A crossed field amplifier was designed to meet the performance objectives of high signal to noise ratio, an efficiency of 85%, a CW microwave power output of 5-8 kW, and a frequency of 2450 MHz. The signal to noise ratio achieved was better than 69 db/MHz in a 2000 MHz band centered on the carrier. High circuit efficiency of 97% and a sharp knee on voltage current characteristic were achieved. The basic problem of maintaining good transfer of heat to the external radiator while providing for adequate connections to input and output was solved. Maximum efficiency achieved was 70.5% and gain and power level were below objectives. An investigation of causes of reduced performance indicated the poor field pattern in the cathode anode interaction area of the tube was a major cause. B.B.

**N78-31144#** ESL, Inc., Sunnyvale, Calif.

**DESCRIPTION OF THE MILSATCOM LOADING PROGRAM OPAL Final Report**

Paul D. Shaft Oct. 1977 58 p refs

(Contract DCA100-77-C-0015)

(AD-A054878; AD-E100057; ESL-TM-888; FR-1) Avail: NTIS HC A04/MF A01 CSCL 22/2

This report describes a computer program that performs loading calculations on military communication satellites. The program interfaces with the JCS approved user requirements data base (URDB) to assess the ability of different satellites to meet stated requirements. Different satellites, priorities, scenarios and time frames may be specified by the user. The program calculates the satellite resources needed to satisfy the requirements. Author (GRA)

**N78-31145#** ESL, Inc., Sunnyvale, Calif.

**USER'S GUIDE FOR THE MILSATCOM LOADING PROGRAM OPAL**

G. D. Heinz Oct. 1977 48 p refs

(Contract DCA100-77-C-0015)

(AD-A054879; AD-E100059; ESL-TM-887; Rept-2) Avail: NTIS HC A03/MF A01 CSCL 22/2

This report describes the use of a computer program that interfaces with the JCS-approved User Requirements Data Base (URDB) to assess the ability of different satellites to meet stated requirements. Input to the program consists of specifications of various program options controlling satellite modeling, the loading algorithm and 'sieves' on the URDB. Output consists of loading results summarized according to several criteria. The program is run in batch on the IBM/370 at Reston, Va, or the IBM/360 at Arlington. Interactive run setup is available at the Reston facility. Author (GRA)

**N78-31146#** ESL, Inc., Sunnyvale, Calif.

**DESCRIPTION OF THE MILSATCOM LOADING PROGRAM OPAL, GPSCS ADDENDUM Final Report**

Paul D. Shaft Mar. 1978 20 p refs

(Contract DCA100-77-C-0015)

(AD-A054880; AD-E100058; ESL-TM-939; FR-3) Avail: NTIS HC A02/MF A01 CSCL 22/2

This report describes modifications that have been made to the OPAL computer program in order to perform loading calculations for GPSCS satellites. The modifications include masking routines to make temporary changes to the URDB and a procedure that allows the program user to generate different satellite configurations. Author (GRA)

**N78-31147#** ESL, Inc., Sunnyvale, Calif.

**USER'S GUIDE FOR THE MILSATCOM LOADING PROGRAM OPAL, GPSCS ADDENDUM Final Report**

G. D. Heinz Mar. 1978 57 p refs

(Contract DCA100-77-C-0015)

(AD-A054881; AD-E100060; ESL-TM-938; FR-4) Avail: NTIS HC A04/MF A01 CSCL 22/2

This report describes the use of a modified computer program that interfaces with the JCS-approved User Requirements Data Base (URDB) to assess the ability of different satellites to meet stated requirements. Input to the program consists of specifications of various program options controlling the loading algorithm and 'sieves' on the URDB. Dynamic modifications to selected entries of the URDB may be specified. Author (GRA)

**N78-31148#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**INVESTIGATION OF REAL-TIME SATELLITE-TO-SATELLITE TRACKING USING EXTENDED KALMAN FILTERS M.S. Thesis**

Henry J. Laughlin Mar. 1978 116 p refs

(AD-A055115; AFIT/GCS/EE/78-3) Avail: NTIS HC A06/MF A01 CSCL 17/9

The feasibility of adapting an extended Kalman filter to the real-time satellitd-to-satellite tracking problem is investigated. A filter using linear propagation and nonlinear measurements is formulated. This filter accepts tracker measurements to provide the state estimates (position, velocity, and acceleration) of the tracked satellite in the local inertial reference frame. Six different filters are programmed in American National Standards Institute (ANSI) FORTRAN. These filters employ various covariance update techniques and methods of processing the measurement vector. The programs are compared for computer program storage requirements, program execution speeds, and computational precision. The computer program storage requirements are determined by utilizing the FORTRAN IV-PLUS compiler on a PDP-11/45 minicomputer. The program execution speeds are found by timing on the PDP-11/45 the filter's reaction to a typical rendezvous between two space vehicles. GRA

**N78-31149#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

**APPLICATION OF A MAXIMUM LIKELIHOOD PARAMETER ESTIMATOR TO AN ADVANCED MISSILE GUIDANCE AND CONTROL SYSTEM**

Rony Dayan Dec. 1977 240 p refs

(AF Proj. 7071)

(AD-A055188; AFIT/GGC/EE/77-3) Avail: NTIS HC A11/MF A01 CSCL 17/7

The problem of parameter estimation using tracking information is examined. Two models are developed and used to estimate the misalignment angles of the inertial system of a missile after its launch. The estimation is based on maximum likelihood concepts. The amount of information extracted from the tracking measurements and the missile specific forces measurements is analysed. A feasibility study of the two models is conducted. The second model uses the aerodynamic model of the missile in order to enhance its estimation ability. Doing this, it incorporates more non-linearities than the first model. These severe non-linearities were found to offset the advantage it had in terms of information gathering. The first model is much simpler in its concept. Yet, it is still able to gather the information needed and its performance is very comparable to the one of the second model. The simplicity and linearity of the first model make it especially attractive. Author (GRA)

**N78-31150#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**STRUCTURED ANALYSIS AND DESIGN OF A SATELLITE SIMULATOR M.S. Thesis**

Kenneth L. Marvin Sep. 1977 109 p refs

(AD-A055192; AFIT/GE/EE/77S-6) Avail: NTIS HC A06/MF A01 CSCL 17/2

The problem addressed in this thesis is the analysis of a complex satellite command system and the design of a software simulation of that system. The problem is solved in three steps. First, a written requirement's definition establishes a sound viewpoint and purpose on which the analyst can base his

design. This requirement's definition explains why the simulator is to be created, how it is to be constructed, and what it is to do. Second, a top-down strategy called 'structured analysis' is applied to create the preliminary design. The structured analysis is presented in a blueprint-type language with activity and data models. The models represent graphically the functions performed by the simulator and the information upon which those functions act. A final design refinement is performed with a structured design methodology called 'transform analysis.' The structure charts drawn during the transform analysis reveal system characteristics which illustrate design quality. The activity model acts as a catalyst to a successful transition from a top-down analysis to a structured design which can be evaluated. The resulting simulator design, with minor revisions, satisfies the design resulting goals established for the project. The methodology used is highly recommended for the analysis and design of any software system. Author (GRA)

**N78-31151#** Army Armament Research and Development Command, Dover, N. J. Large Caliber Weapon Systems Lab.
**THREE-BEACON PROJECTILE GUIDANCE STUDY Final Technical Report**
John R. Masly and Richard A. Haddad Mar. 1978 128 p
(AD-A055992; AD-E400159; ARLCD-TR-77080) Avail: NTIS HC A07/MF A01 CSCL 19/1

The feasibility of employing an array of three ground-based beacons operating as distance measuring equipment (DME) transponders to accurately guide a projectile to a target is explored. For simplification of the problem, the projectile is assumed to be a point mass, with only drag, gravity and control forces acting on it. A projected planar guidance law is adopted for the projectile and it is assumed that the guidance law can be implemented exactly. Estimates of targeting errors are obtained by computer simulation, as functions of beacon-to-beacon spacing, guidance cut-off altitude, terminal velocity, and beacon location errors. Results of a statistical analysis on the computer simulations indicate that the major parameters affecting the desired accuracy at the target are beacon-to-beacon spacing and beacon-target geometry. Author (GRA)

**N78-31152#** Naval Surface Weapons Center, Dahlgren, Va.
**THEORETICAL AND EXPERIMENTAL METHODS IN THE SOLUTION OF MISSILE NONLINEAR ROLL PROBLEMS**
Peter Daniels and Samuel R. Hardy Mar. 1978 55 p refs (WF323000)
(AD-A055718; NSWC/DL-TR-3773) Avail: NTIS HC A04/MF A01 CSCL 19/4

This report is a comprehensive documentation of recently developed experimental and theoretical methods dealing with the solution of free flight missile nonlinear roll problems. A unified approach to the development of a nonlinear rolling motion theory for finned missiles as well as a passive roll rate stabilization technique are described. Author (GRA)

**N78-31153#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Flugkoerperantriebe.
**THE USE OF RAM ROCKETS FOR HIGH ALTITUDE MISSILES**
Egbert Riester 18 Nov. 1977 60 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-505)
(DLR-FB-77-47) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 29,60

The applicability of ram rockets for the propulsion of high altitude missiles was investigated. As a power plant for the cruising phase of high altitude supersonic missiles, rockets and ram rockets are competing with each other. The conditions are shown, under which the ram rocket is superior. The influence of mission and power plant parameters on the payload of both kinds of power plants is investigated. The advantage of the combination booster - ram rocket over a two stage rocket under altitude conditions is pointed out. The advantage may increase, if the booster acceleration is finished before reaching the cruise velocity, and the ram rocket is continuing the acceleration. At a definite booster and velocity the payload becomes a maximum. The control regimes of the ram rocket combustion chamber, being necessary to maintain the maximum conditions, are shown. Author (ESA)

**N78-31154#** British Aircraft Corp. (Operating) Ltd., Bristol (England). Electronic and Space Systems.
**STUDY OF ATTITUDE CONTROL SYSTEMS USING THE EARTH'S MAGNETIC FIELD AT SYNCHRONOUS ALTITUDES Final Report**
R. S. Harris Paris ESA Apr. 1978 364 p
(Contract ESTEC-2850/76)
(ESS/SS-834; ESA-CR(P)-1071) Avail: NTIS HC A16/MF A01

Those control functions, typical of spin stabilized and three axis stabilized momentum biased satellites that are suitable for implementation by magnetic control concepts, are discussed and detailed design of such control systems is presented including hardware and interface requirements. A model of the geomagnetic field at geosynchronous altitude was derived including three basic field components - one generated within the earth, one generated by current systems within the magnetosphere, and one generated by disturbance field. Using a simplified form of this field model, the feasibility of performing magnetic control was assessed for both the spin and three axis stabilized satellites. The results demonstrate that magnetic torquing cannot be used when large momentum changes are required. During normal pointing, it does provide a viable means of: 1) controlling the spin axis orientation and spin rate on the spin stabilized mission; 2) partially offsetting the roll and yaw disturbance torques on the three axis stabilized mission using either a Fixed Momentum Wheel (FNW) in geostationary orbit or a Single Gimballed Momentum Wheel (SGMW) in a low inclination, circular geosynchronous orbit; and 3) controlling the roll and yaw attitude on the above FNW and SGMW systems. Magnetic control schemes were designed for the above three functions and their performance was assessed under both magnetically quiet and magnetically disturbed conditions. The specific hardware and operational requirements for each system - the dimensions, mass and power characteristics of the magnetic sensors, coils and associated electronics and the telemetry/telecommand requirements - were identified. Interface requirements on the remainder of the satellite are discussed. Author (ESA)

# 16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

No abstracts in this category.

# 17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

**N78-31155*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**NODDING FEED ANTENNA FOR COMMUNICATIONS WITH SATELLITES IN SYNCHRONOUS ORBIT**
Jerry Smetana and Ralph Zavesky 1978 25 p refs Presented at the 1978 Antenna Appl. Symp., Monticello, Ill., 20-22 Sep. 1978
(NASA-TM-78989; E-9771) Avail: NTIS HC A02/MF A01 CSCL 17B

The design, fabrication, and performance of a parabolic, ground

receiving antenna system with a feed that nods in one axis producing a maximum beam deviation 1.1 deg from boresight is described. The antenna design was: (1)to lower the weight (and the subsequent cost) of the supporting structure and the actuator motors for a tracking antenna by moving just the feed; (2) to use a manual tracking system eliminating the need for expensive electronic controls or computers; (3) to provide for several hours of unattended operation; and (4)to permit operation of the antenna by unskilled personnel. Also described are some physical and orbital phenomenon that effect the operation or design of the antenna. One is the motion of a nearly geostationary satellite due to gravitational forces from the sun, the moon, and other stellar bodies. Others are the rotation of the nodding axis and the feed polarization as a function of the location of the station on the earth. A comparison of per unit cost was made for one unit and a quantity of 100. B.B.

**N78-31156#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**A GENERALIZED MONTE CARLO ANALYSIS PROGRAM FOR KALMAN FILTER DESIGN WITH APPLICATION TO AN AIRCRAFT-TO-SATELLITE TRACKING FILTER M.S. Thesis**
Kenneth L. Jackson, Jr. Dec. 1977 311 p refs
(AD-A055189; AFIT/GGC/EE-77-6) Avail: NTIS HC A14/MF A01 CSCL 17/7

A generalized Monte Carlo Analysis Program (MCAP) has been developed for linear or extended Kalman filter design. A detailed users: guide for MCAP is included in Appendix A. In addition, this study treats the high accuracy tracking of a satellite from an aircraft. The purpose of the study is to evaluate the feasibility of a reduced order system model for implementation in an extended Kalman filter formulation whose estimates would be used to aid the tracker. The six state model accomplishes tracker state estimation by exploiting the information already available in the tracking geometry, dominant modes of satellite dynamics, and the range measurement. Tracker state estimation is accomplished in the line-of-sight coordinate frame. A Monte Carlo analysis was performed, evaluating the filter against a 42-state truth model. With some proposed modifications, it was concluded that the six state filter is feasible and warrants further study. GRA

# 18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

**N78-31157#** European Space Research and Technology Center, Noordwijk (Netherlands). Product Assurance Div.
**CONFIGURATION MANAGEMENT REQUIREMENTS**
Paris ESA 16 Mar. 1978 20 p
(ESA-Spec-QRA-03-Issue-3) Avail: NTIS HC A02/MF A01

Procedures are given for a configuration management plan for ESA flight and support equipment, and when applicable, experiments design and development projects to be established by the contractor for ESA approval. The requirements for the plan foresee organizational elements (configuration management office, configuration control board, and data management), configuration identification (items, document, hardware), configuration control (baseline management), change control, interface management, configuration status accounting, and subcontractor configuration management. ESA

**N78-31158#** European Space Research and Technology Center, Noordwijk (Netherlands). Product Assurance Div.
**STANDARD PARTS LIST FOR ESA PROJECTS**
Paris ESA Nov. 1977 93 p
(ESA-Spec-QRC-04-Issue-1-Rev-1) Avail: NTIS HC A05/MF A01

Preferred electronic components for use by designers, project parts engineers, product assurance engineers, and responsible project design authorities are tabulated. They were selected from current project parts lists. The list of preferred parts includes cables, capacitors, connectors, diodes, filters, inductances, integrated circuits, relays, resistors, transistors. European companies recommended as preferred suppliers on the one hand and as potential suppliers on the other are listed. Author (ESA)

# 19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

No abstracts in this category.

# 20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

**N78-31159*#** Teledyne/McCormick Selph, Hollister, Calif.
**QUALIFICATION TEST FOR SAFETY AND ARMING DEVICE MSFC PN 10A00465 TMc/S PN 816780 FOR SPACE SHUTTLE SOLID ROCKET BOOSTER, VOLUME 1 Final Program Report**
7 Aug. 1978 55 p
(Contract NAS8-31973)
(NASA-CR-150791; QTR-4918-245-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 21H

The design and development of a safety and arming device for the space shuttle solid rocket booster is reported. Results of lot acceptance tests and qualification tests are given and discussed. J.M.S.

**N78-31160*#** Teledyne/McCormick Selph, Hollister, Calif.
**QUALIFICATION TEST FOR SAFETY AND ARMING DEVICE MSFC PN 10A00465 TMc/S PN 816780 FOR SPACE SHUTTLE SOLID ROCKET BOOSTER, VOLUME 1, SECTION 2 Final Program Report**
7 Aug. 1978 372 p
(Contract NAS8-31973)
(NASA-CR-150792; QTR-4918-245-Vol-1-Sect-2) Avail: NTIS HC A16/MF A01 CSCL 21H
For abstract, see N78-31159.

**N78-31161*#** Teledyne/McCormick Selph, Hollister, Calif.
**QUALIFICATION TEST FOR SAFETY AND ARMING DEVICE MSFC PN 10A00465 TMc/S PN 816780 FOR SPACE SHUTTLE SOLID ROCKET BOOSTER, VOLUME 2 Final Program Report**
Frank Mortela and C. E. Campbell 7 Aug. 1978 327 p
(Contract NAS8-31973)
(NASA-CR-150793; QTR-4918-245-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 21H
For abstract, see N78-31159.

**N78-31162*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**A PRESSURE LIMITING PROPELLANT ACTUATING SYSTEM Patent Application**
Paul B. Reese (Rockwell International, Downey, Calif.) and David W. Murphy, inventors (to NASA) (Rockwell International, Downey, Calif.) Filed 4 Aug. 1978 13 p
(Contract NAS9-14000)

(NASA-Case-MSC-18179-1; US-Patent-Appl-SN-931218) Avail: NTIS HC A02/MF A01 CSCL 21H

A pressure limiting propellant activating system for simultaneously limiting the output force while maintaining a constant output pressure from the combustion chamber is described. The propellant actuating system includes an outer barrel, outer housing and a combustion chamber. A main piston is movable in the barrel housing when gas pressure is developed in the combustion chamber. A relief piston is concentrically mounted and fixedly movable with the main piston when gas pressure is exerted from the combustion chamber. A relief piston has a force-activated separation mechanism for limiting the output force while simultaneously maintaining constant output pressure on the main piston from the combustion chamber. NASA

**N78-31163*#** Aerojet Liquid Rocket Co., Sacramento, Calif.
**ORBIT TRANSFER VEHICLE (OTV) ENGINE PHASE A STUDY Bi-Monthly Status Report, 10 Jul. 1978 - 31 Jul. 1978**
J. A. Mellish 15 Aug. 1978 30 p refs
(Contract NAS8-32999)
(NASA-CR-150796; Rept-32999-M1) Avail: NTIS HC A03/MF A01 CSCL 21H

Requirements for the orbit transfer vehicle engine were examined. Engine performance/weight sensitivities, the effect of a service life of 300 start/shutdown cycles between overalls on the maximum engine operating pressure, and the sensitivity of the engine design point (i.e., thrust chamber pressure and nozzle area ratio) to the performance requirements specified are among the factors studied. Preliminary engine systems analyses were conducted on the stage combustion, expander, and gas generator engine cycles. Hydrogen and oxygen pump discharge pressure requirements are shown for various engine cycles. Performance of the engine cycles is compared. J.M.S.

**N78-31164*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**LIQUID ROCKET ENGINE AXIAL-FLOW TURBOPUMPS Space Vehicle Design Criteria (Chemical Propulsion)**
D. D. Scheer, M. C. Huppert (Rocketdyne), F. Viteri (Aerojet Liquid Rocket Co.), J. Farquhar (Aerojet Liquid Rocket Co.), and Russell B. Keller, Jr., ed. Apr. 1978 127 p refs
(NASA-SP-8125) Avail: NTIS HC A07/MF A01 CSCL 21H

The axial pump is considered in terms of the total turbopump assembly. Stage hydrodynamic design, pump rotor assembly, pump materials for liquid hydrogen applications, and safety factors as utilized in state of the art pumps are among the topics discussed. Axial pump applications are included. J.M.S.

**N78-31165#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (West Germany). Inst. fuer Chemische Antriebe und Verfahrenstechnik.
**HOT GAS SIDE HEAT TRANSFER COEFFICIENTS IN HIGH ENERGY ROCKET ENGINES WITH THRUST VARIATION**
Hans J. Sternfeld 15 Sep. 1977 68 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-502)
(DLR-FB-77-42) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 29,90

The hot gas side heat transfer coefficient and heat flux in the combustion chamber and nozzle of oxygen/hydrogen, fluorine/hydrogen, and fluorine/ammonia rocket engines were determined. Thrust variation of the capacitatively cooled experimental rocket engines between 200 N and 1 500 N was provided by a combustion chamber pressure variation between 3 bars and 15 bars. The results are presented as correlation equations of the form St=A x Re(B) x Pr(C). A novel calculation procedure was applied for determining the local hot gas side heat transfer coefficient from the measured unsteady wall temperature distribution of the engine. The one-dimensional analysis was based on the integral form of the energy conservation law for the heat conductor. The measured temperature field was approximated by approximation functions in space and time. Author (ESA)

**N78-31166#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (West Germany). Inst. fuer Chemische Antriebe und Verfahrenstechnik.
**ENERGY LOSSES IN HIGH ENERGY ROCKET ENGINES WITH THRUST VARIATION**
Hans J. Sternfeld 15 Sep. 1977 102 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol. Report will also be announced as translation (ESA-TT-516)
(DLR-FB-77-41) Avail: NTIS HC A06/MF A01; DFVLR, Cologne DM 43,50

The effect of various parameters on the energy losses in the combustion chambers of oxygen/hydrogen, fluorine/hydrogen, and fluorine/ ammonia rocket engines was investigated. A thrust variation of the capacitatively cooled experimental rocket engines between 200 N and 1,500 N was provided by a combustion chamber pressure variation between 3 bars and 15 bars. The energy losses of a fluorine/ammonia rocket engine were compared with results obtained with the Distribution Energy elease computer model. The results of the investigation are presented as two-dimensional approximation functions. The energy losses of rocket engines with coaxial injectors can be described by the two parameters MIXEFF and VAPTIME, which characterize the imperfect mixing and the incomplete vaporization of the propellants. Author (ESA)

# 23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

**N78-31167** California Univ., Los Angeles.
**STRUCTURE AND DYNAMICS OF ORGANIC MATERIALS UNDER HIGH PRESSURE Ph.D. Thesis**
Joseph Marcus Wiget 1978 186 p
Avail: Univ. Microfilms Order No. 7813960

The kinetics of the high pressure phase two to phase three transformation for polytetrafluoroethylene was studied using pressure-jump techniques and Raman spectroscopy. Construction of a synchronously mode-locked cavity-dumped dye laser is described. This system consists of a mode-locked argon laser operating at 83 MHz which synchronously pumps a cavity-dumped rhodamine 6G dye laser with an extended cavity length matched to the length of the argon laser. Flourescence lifetimes of two different species in 1,1'-binaphthyl at high pressure were measured using photon counting techniques, digital data acquisition, and computed deconvolution of the data. A new technique for growing large single crystals of dianthracene is reported, and polarized Raman spectra of dianthracene obtained with these crystals are described. Dissert. Abstr.

**N78-31168#** North Carolina Univ., Chapel Hill. Dept. of Chemistry.
**UNUSUAL MAGNETIC PROPERTIES IN TWO COPPER (II) CHELATES OF SCHIFF BASES DERIVED FROM ALPHA-AMINO ACIDS: A DIMERIC INTERACTION IN A STRUCTURAL LINEAR CHAIN**
William E. Estes and William E. Hatfield 22 May 1978 36 p refs
(Contract N00014-76-C-0816)
(AD-A055101; TR-4) Avail: NTIS HC A03/MF A01 CSCL 07/3

Ordinarily one expects the structural and magnetic properties of a given substance to be intimately related, with the dimensionality of the magnetic or electrical interactions that are present reflecting the lattice dimensionality. For example, a cluster of two interacting magnetic ions should obey a theoretical model whose statistics treat only the pair of interacting spins. Systems in which there are interactions between a small number of spins in a definable cluster within a macroscopic crystal are considered to be zero-dimensional (O-D) from a lattice viewpoint. Each cluster is assumed to be isolated from neighboring clusters in the crystal structure, and interactions of spins of the individual clusters with the spins on neighboring clusters are assumed to be absent. This basic idea may be generalized to include one dimensional chains (1-D) and two-dimensional layers (2-D). Eventually such a process leads to the ultimate reality of a three-dimensional

(3-D) crystal structure in which there are more or less equally interacting near neighbors. Author (GRA)

**N78-31169#** Alabama Univ., University. Dept. of Chemistry.
**THE VINYL REACTIVITY OF (ETA(5)-VINYLCYCLOPENTADIENYL) DICARBONYL NITROSYLCHROMIUM. A NOVEL VINYL ORGANOMETALLIC MONOMER Interim Report**
Charles U. Pittman, Jr., Thane D. Rounsefell, Edwin A. Lewis, John E. Sheats (Rider Coll., Trenton), Bruce H. Edwards (Rider Coll., Trenton), Marvin D. Rausch (Mass. Univ., Amherst), and Eric A. Mintz (Mass. Univ., Amherst) 22 May 1978 32 p refs
(Contract N00014-75-C-0689; Grant NSF DMR-77-06810) (AD-A055012; TR-21) Avail: NTIS HC A03/MF A01 CSCL 07/3

The novel vinyl organometallic monomer (eta(5)-vinylcyclopentadienyl) dicarbonylnitrosylchromium (hereafter called vinylcynichrodene), recently prepared, was homopolymerized and copolymerized in the presence of azo initiators, both neat and in benzene solutions. Reactivity ratios were obtained in radical-initiated copolymerizations with styrene and N-vinyl-2-pyrrolidone. The resonance interaction parameter Q was 3.1 for vinylcynichrodene. Copolymerizations with N-vinyl-2-pyrrolidone (M2) gave r1 - 5.3, r2 = 0.079 and e1 = -2.07. Thus, it is clear that vinylcynichrodene is an exceptionally electron-rich vinyl monomer resembling vinylferrocene and vinylcymantrene. Vinylcynichrodene readily copolymerized with vinylcymantrene and homopolymerized in high yields in ethyl acetate solution. The molecular weight of poly(vinylcynichrodene) increased as the monomer to initiator ratio increased suggesting that the rate was not first order in initiator as had been found previously in vinylferrocene polymerizations. GRA

**N78-31170#** Department of Energy, Washington, D. C. ERDA Materials Coordinating Committee.
**SURVEY AND ANALYSIS OF SELECTED TOPICS WITHIN THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION'S (ERDA) MATERIALS RESEARCH AND DEVELOPMENT PROGRAMS**
Jan. 1978 137 p
(Contract W-7405-eng-26)
(DOE/ET-0006) Avail: NTIS HC A07/MF A01

A review of the following is presented: (1) structural alloy development; (2) nondestructive testing; (3) structural ceramics development; (4) general corrosion; (5) erosion and wear; and (6) effects of hydrogen on materials. Author (ERA)

## 24 COMPOSITE MATERIALS

Includes laminates.

**N78-31171** Alfred Univ., N.Y.
**FABRICATION AND MECHANICAL PROPERTIES OF ALUMINA FIBER-ALUMINA MATRIX COMPOSITES Ph.D. Thesis**
James William Congdon 1978 147 p
Avail: Univ. Microfilms Order No. 78-13214

Processing and fabrication techniques were designed to optimize the microstructure of an alumina fiber-alumina matrix composite. Specimens were formed by pressure slip casting, further densified by isostatic pressing, presintered at 1275 C, sectioned, and sintered at 1500 C. The strength and fracture toughness of the composite were tested as a function of fiber length and fiber content. The thermal shock damage resistance of the composite exhibiting maximum fracture toughness was compared to that of unreinforced alumina. Characterization of sintered microstructures and fractographic studies aided in the interpretation of the results. Fibers could be dispersed satisfactorily at concentrations of up to 15 volume percent with less than two percent fiber induced porosity. The effects of fiber concentration and fiber length on the mechanical properties were attributed primarily to the nature of the fiber induced porosity. Dissert. Abstr.

**N78-31172** Washington Univ., Seattle.
**THE INTERRELATIONSHIPS OF DENSITY AND FIBER ORIENTATION ON THE MECHANICAL PROPERTIES OF FIBERBOARD Ph.D. Thesis**
Shan-Tung Hsu 1977 97 p
Avail: Univ. Microfilms Order No. 7814446

Fiberboards were fashioned with four levels of orientation (including random orientation) and with five densities ranging from 0.40 to 1.00 gm/cu cm. It was demonstrated that the degree of fiber alignment is related to the consistency of fiber slurry for the oriented boards. The degree of fiber alignment was measured by a fiber orientation index. Boards were evaluated by measuring the modulus of elasticity and the modulus of rupture. Fiber alignment benefits the mechanical properties in the alignment direction and adversely affects strength in the perpendicular-to-alignment direction. The simplified orientation index was compared with two other commonly used orientation indicators: average fiber angle and strength ratios (parallel to perpendicular to the axis). A mathematical formula was derived to express the relationship between the orientation index and average fiber angle. Dissert. Abstr.

**N78-31173#** Fiber Materials, Inc., Biddeford, Maine.
**FABRICATION OF GRAPHITE-ALUMINUM COMPOSITES VIA PULTRUSION Final Report**
Horst Gigerenzer and Gary C. Strempek Mar. 1978 33 p refs
(Contract DAAG46-77-C-0036; DA Proj. 1T1-63102-D-071) (AD-A055257; AMMRC-TR-78-16) Avail: NTIS HC A03/MF A01 CSCL 13/8

The objective of this program was to establish the feasibility of producing sound rectangular bars by the pultrusion process. Previous work conducted under contract DAAG-46-76-C-0068 identified process problems for non-round sections. Addressed in the present work were: (1) Elimination of rectangular bar twisting during pultrusion; (2) Surface improvement by application of thin aluminum claddings; (3) Incorporation of thin titanium interleaf to the composite; and (4) Further evaluations of composite heat-treatability without cracking. Rectangular bars of improved geometric uniformity, clad with aluminum and optionally interleafed with titanium were successfully fabricated by pultrusion processing. Twelve bars were delivered to AMMRC for evaluation. It was concluded that the pultrusion technology developed thus far has potential for the future fabrication of clad and/or interleafed, uniaxially graphite fiber reinforced aluminum-matrix, composite structural members. GRA

**N78-31174#** Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
**TF30 THIRD-STAGE COMPOSITE FAN BLADE SERVICE PROGRAM Final Technical Report, 1 Jul. 1970 - 31 Dec. 1977**
David G. Randall 15 May 1978 369 p
(Contract F33657-70-C-0624)
(AD-A055891; PWA-5141; PWA-FR-10097) Avail: NTIS HC A16/MF A01 CSCL 01/3

The successful application of advanced composites, as the structural material for aircraft jet engine rotating parts, will significantly reduce engine weight and improve engine performance characteristics. To solve the component design, manufacturing, and quality assurance problems associated with such an application, a program was conducted to design and develop BORSIC/Aluminum third-stage fan blades, which would operate satisfactorily in the TF30-P-7 or P-9 engine models. Program objectives were to improve the existing design of a composite material fan blade, manufacture the blade, and demonstrate its quality by bench and engine environment testing. The scope of the program required to successfully meet these objectives included establishing design and fabrication procedures, developing special tooling, evaluating current nondestructive inspection techniques and adapting these techniques to composite materials, establishing quality assurance criteria, and developing comprehensive bench and engine environment test programs to adequately demonstrate fan-blade quality. During the program, several sets of BORSIC/Aluminum blades weighing 40 percent less than comparable TF30 bill of material titanium blades were successfully produced and tested. Based on this extensive test program, and with the establishment of quality control criteria

and repair procedures, the blades were deemed acceptable for evaluation in a flight program. During the total program, 246 engine-configuration blades were manufactured and non-destructively inspected; with an overall acceptance rate of 92.3%. GRA

**N78-31175#** Materials Sciences Corp., Blue Bell, Pa.
**EFFECTS OF ENVIRONMENT, AND DAMPING AND COUPLING PROPERTIES OF COMPOSITE LAMINATES ON PANEL FLUTTER Final Report, 1 Mar. 1976 - 30 Nov. 1977**
Sailendra N. Chatterjee and Satish V. Kulkarni Jan. 1978 135 p refs
(Contract F44620-76-C-0080)
(AD-A055753; MSC/TFR/802/1151; AFOSR-78-1066TR)
Avail: NTIS HC A07/MF A01 CSCL 11/4

The dynamic response of composite materials has been investigated with the objective of assessing the influence of the geometry and the material variables upon the vibrational frequencies and dispersion characteristics in composite laminates. These studies are an essential first step in assessing the response of a structure subjected to more complex transient and aerodynamic loads which are frequently experienced in aerospace structures. A direct and important consequence of aerodynamic loading on structures is flutter, which can be defined as the dynamic instability of an elastic body in an airstream. A form of oscillatory instability which differs from the more conventional lifting surface flutter is panel flutter, which is the interaction between the missile or aircraft surface skin panel motions and aerodynamic forces in the supersonic regime. GRA

**N78-31176#** Sandia Labs., Albuquerque, N. Mex.
**RF PLASMA ENHANCED VAPOR DEPOSITION AND ETCHING OF SILICON NITRIDE**
R. E. Hampy Feb. 1978 56 p refs
(Contract EY-76-C-04-0789)
(SAND-77-2070) Avail: NTIS HC A04/MF A01

The deposition and etching of silicon nitride films using RF plasma techniques is reported. Experiments were conducted to determine optimum operating parameters (e.g., gas flow rates, temperature, power and pressure) for the Applied Materials Technology Plasma 1 reactor in both the deposition and etching modes of operation. Silane and ammonia with nitrogen as a carrier gas were used during deposition. Film properties were measured as selected operating parameters were changed in deposition experiments. Good quality Si3N4 films for semiconductor device passivation purpose were made in thicknesses of 300 to 10,000 A with refractive indexes between 2.0 and 2.1 and at deposition rates of 250-300 A/min. The relativity low deposition temperature makes the process compatible with devices metallized with aluminum. Plasma etching of Si3N4 films using tetrafluoromethane with 8% oxygen added was successful using standard photoresists and at etch rates of 400-1000 A/min. ERA

**N78-31177#** Rockwell International Science Center, Thousand Oaks, Calif.
**STRUCTURE OF GAIN BOUNDARIES IN SILICON NITRIDE BASED ALLOYS**
D. R. Clarke and G. Thomas (Calif. Univ., LBL) Dec. 1977 21 p refs Presented at the 14th Conf. on Ceramic Sci. Processing of Crystalline Ceramics, Raleigh, North Carolina, 7 Nov. 1977
(Contract W-7405-eng-48)
(LBL-6985; Conf-771137-3) Avail: NTIS HC A02/MF A01

Grain boundaries in silicon-based ceramics were characterized by high resolution electron microscopy including the technique of lattice fringe imaging. Examples from both hot-pressed silicon nitrides (MgO and Y2O3 fluxed) and a magnesium-sialon are given. Room temperature observations of the glassy phase are consistent with it being only a partially wetting phase, indicating that it cannot form a continuous film. The atomic configuration of the grain boundaries in both materials is presented together with lattice fringe observations of segregation at grain boundaries in the magnesium-sialon. ERA

**N78-31178#** Oak Ridge National Lab., Tenn.
**SYSTEM FOR VACUUM POURING OF EPOXY TENSILE AND IMPACT SPECIMENS WITH A STUDY OF THE BEHAVIOR OF THESE SPECIMENS AT 77 K AND 293 K**
C. M. Fitzpatrick and W. C. T. Stoddart Mar. 1978 11 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5493) Avail: NTIS HC A02/MF A01

A suitable technique for vacuum pouring of epoxy test specimens is described and the behavior of these specimens at 77 K and 293 K are studied. A series of tensile and impact tests was conducted using specimens made from the following resins: Epon 828, Epon 871, and Epon curing agent Z. The two main features of the vacuum pouring apparatus are: (1) batches can be poured under near-identical conditions; and (2) samples can be handled free from air contamination. ERA

**N78-31179#** Dornier-System G.m.b.H., Friedrichshafen (West Germany).
**EVALUATION OF BUILT-IN STRESSES DURING MANUFACTURE OF ELEMENTS MADE OF CARBON FIBER REINFORCED PLASTICS Final Report**
M. W. Schneermann and H. D. Stenzenberger Paris ESA Jan. 1978 146 p refs Prepared jointly with Technochemie GmbH, Heidelberg
(Contract ESTEC-2930/76-NL-PP(SC))
(ESA-CR(P)-1058) Avail: NTIS HC A07/MF A01

An evaluation of the curing of stresses in carbon fiber reinforced plastic (CFRP) was made and ways to reduce those built-in stresses were studied. The structures were of the sandwich type and consisted of a honeycomb core and CFRP face skins. Mathematical tools for the analytical prediction of curing stress are given. Mathematical models were verified by tests of crossplied and quasi-isotropic skins with built-in fabricational tolerances such as different layer thicknesses or unsymmetrical resin content. Experimental data showed that a thermal cycling to low temperatures reduces distortions, which are caused by built-in stresses, and stabilized the thermal expansion characteristics of CFRP. Recommendations for a stress-relief procedure and sandwich manufacturing are given. Tests on flat sandwiches showed a higher dimensional accuracy for samples with stress-relieved face skins compared to those with untreated skins. Author (ESA)

**N78-31180#** Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.
**DEVELOPMENT OF SOLAR REFLECTOR MATERIAL WITH GOOD ELECTRICAL CONDUCTIVITY. VOLUME 1: PHASE 1 STUDY [MISE AU POINT DE MATERIAUX COMBINANT LA QUALITE DE REFLECTEUR ET UNE BONNE CONDUCTIBILITE ELECTRIQUE. TOME 1. RAPPORT SUR LA PHASE 1]**
A. Paillous, J. C. Guillaumon, L. Levy, M. Marco, H. Oscar, D. Sarrail, and M. Soulet Paris ESA Jan. 1978 104 p refs In FRENCH
(Contract ESTEC-3184-NL/77-HP(SC))
(ESA-CR(P)-1069) Avail: NTIS HC A06/MF A01

Conductive thermal control coatings for use in satellite structures were studied. Material produced by various manufacturers was evaluated and tests on prospective material were made, notably with regard to thermooptical properties, charge accumulation by low energy electrons (5-20 keV) and electric breakdown. Three different types of material were studied: transparent conductive layers deposited on elastic polymeric material; silicon dioxide fabrics; material that can be used as pigments or conductive paint charges. ESA

# 25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

**N78-31181** California Univ., San Diego.
**THE REDUCTION OF MOLECULAR NITROGEN, ORGANIC**

**SUBSTRATES AND PROTONS BY VANADIUM(II) Ph.D. Thesis**
Stacy Ian Zones 1978 180 p
Avail: Univ. Microfilms Order No. 7813156

The mechanism of molecular nitrogen reduction by vanadium(II) in an alkaline magnesium hydroxide lattice was studied by following the details of the reduction of molecular nitrogen, as well as a variety of organic substrates. The accompanying evolution of hydrogen in this system also studied and provided key insights into the mode of nitrogen fixation. Reactions were followed, as a function of time and the dependence on various reactants. Samples of the reaction mixture were taken and analyzed by colorimetry, gaschromatography, mass spectroscopy, absorption spectroscopy, or by infrared spectroscopy. A number of competitive substrate or noncompetitive inhibitor type reactions were useful in elucidating the details of the reactivity of vanadium(II) under these conditions. Dissert. Abstr.

**N78-31182** Temple Univ., Philadelphia, Pa.
**STUDIES IN FLUORESCENCE SPECTROSCOPY Ph.D. Thesis**
Alfred Lee Findeisen 1978 121 p
Avail: Univ. Microfilms Order No. 7812205

The calibration procedure for the Perkin-Elmer MPF-2A is presented. The corrected spectra produced is utilized to obtain the fluorescence quantum yield of 9,10-diphenylantracene in cyclohexane relative to quinine bisulfate in 1N $H_2SO_4$. Polarization corrections are also considered. A formula for computing quantum yield of fluorescence is derived which differs from that in universal use. Under general conditions, it can be put in a form which involves a correction factor applied to the formula usually employed. The corrections exceed experiment errors, and may be quite large in some cases. Dissert. Abstr.

**N78-31183** Michigan Univ., Ann Arbor.
**THE APPLICATION OF EXPLODING THIN FILMS TO TRACE METALS ANALYSIS Ph.D. Thesis**
David Victor Duchane 1978 246 p
Avail: Univ. Microfilms Order No. 78-13640

Attempts were made to develop exploding thin films as excitation source/sample cell composites for trace metals analysis of micro samples by spectroscopic techniques. Initial studies involved the preparation of thin films by vacuum deposition. Examination of two classes of substrate materials demonstrated that thin aluminum films on high density polyethylene substrates yield consistently more reproducible results than those obtained with similar films on glass substrates. The results of an extensive parametric study involving explosions conducted in air and argon at a number or pressures, as well as at various discharge energies, discharge voltages, and circuit capacitance levels, indicate that explosions conducted in dry air at 300 torr with a discharge energy of 180 J are most useful from an analytical point of view. Dissert. Abstr.

**N78-31184** California Univ., Berkeley.
**TRANSITION METAL ION BINDING BY FERRITIN AS STUDIES BY ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY Ph.D. Thesis**
Duane Lee Lindner 1977 143 p
Avail: Univ. Microfilms Order No. 7812660

The binding of several transition metal ions by the iron storage protein, ferritin, was examined, as well as its iron-free derivative, apoferritin. The ions studies include ferric ion, manganous ion, cuprous and cupric ions, and vanadyl ion. The primary technique used in these investigations was electron paramagnetic resonance spectroscopy. Ferric ion was found to bind to both ferritin and apoferritin in a site of rhombic crystal field symmetry. Cupric ion was found to bind in two different ways. One way involves a copper tight-binding site which strongly and specifically binds the element. The binding was highly pH dependent with as many as two ions per protein submit binding to both ferritin and apoferritin. The protein binds each cupric ion with three nitrogenous ligands arising from both histidine and lysine amino acid residues. Dissert. Abstr.

**N78-31185** Michigan Univ., Ann Arbor.
**NONLINEAR TREATMENT OF SELF-DIFFUSION IN LIQUIDS Ph.D. Thesis**
Hiroshi Matsumura 1978 124 p
Avail: Univ. Microfilms Order No. 78-13698

The nonlinear effects involved in self diffusion of liquids are evaluated in order to explain unresolved properties of the incoherent scattering law related to k-dependence. The self diffusion of a classical simple liquid was investigated using a renormalization technique involving a generalized Fokker-Planck operator that requires the evaluation of the equilibrium ensemble average of a delta functional defined for a set of dynamical variables representing a state of the system and its final realization. The method was used to examine the hydrodynamic mode coupling which explains the long time tail of the velocity autocorrelation function found in computer simulations. In order to recover the missing k-dependence of the incoherent scattering law, the slowness assumptions required for the derivation of the generalized Fokker-Planck equation must be avoided. Dissert. Abstr.

**N78-31186#** IBM Watson Research Center, Yorktown Heights, N.Y.
**NONLINEAR SPECTROSCOPY Final Report, 1 Mar. 1975 - 28 Feb. 1978**
James J. Wynne 28 Apr. 1978 8 p refs
(Contract DAAG29-75-C-0016)
(AD-A055076; ARO-13013.16-P) Avail: NTIS HC A02/MF A01 CSCL 07/4

Using the technique of multiphoton ionization spectroscopy, we have studied Rydberg series of states in the alkaline earth atoms Ca, Sr and Ba. Long series of states not previously identified were observed and analyzed using multichannel quantum defect theory. GRA

**N78-31187#** Aerodyne Research, Inc., Bedford, Mass. Center for Chemical and Environmental Physics.
**DESIGN OF A FLOW FACILITY FOR QUANTITATIVE SPECTROSCOPIC STUDIES OF HIGH TEMPERATURE SPECIES Interim Report**
Michael E. Gersh and Charles E. Kolb Apr. 1978 22 p refs
(Contract F49620-77-CC-0075; AF Proj. 2303)
(AD-A054842; ARI-RR-121; AFOSR-78-0966TR) Avail: NTIS HC A02/MF A01 CSCL 11/2

The objective of this study is the measurement of the infrared absorption coefficients and absorption line spacing of several boron compounds in the gas phase over the temperature range of 300 to 1500 K. In the past year, the following technical progress was made. The apparatus was designed, and the variable temperature flow tube in which the boron compounds are made by reaction was constructed. In initial tests the flow reactor achieved its design temperature of 1500 K, while using only half of the available power of the heating elements. In addition, a separate flow simulation experiment in a scale model of the flow tube was used to verify the design of the critical spectroscopic analysis region and to establish the range of flow conditions over which the flow will be well behaved. Finally, the optical system for the low resolution spectroscopic measurements was fabricated and assembled on the apparatus.
Author (GRA)

**N78-31188#** Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
**A TECHNIQUE FOR EVALUATING FUEL AND HYDRAULIC FLUID BALLISTIC VULNERABILITY Interim Report**
B. R. Wright and W. D. Weatherford Dec. 1977 25 p refs
(Contracts DAAG53-76-C-003; DAAK70-78-C-001)
(AD-A055058; AFLRL-89) Avail: NTIS HC A02/MF A01 CSCL 11/8

A relatively inexpensive ballistic test procedure has been developed for evaluating the relative fire vulnerability of various fluids of interest for Army applications. The technique employs 20 mm HEIT projectiles fired into partly-filled fluid containers. It yields repeatable results which establish both transient fireball effects and residual burning tendencies. Appropriate experimental procedures and conditions, such as target fluid temperature, were established, and the efficacy and repeatability were evaluated by conducting a total of 184 experiments, 81 of which are tabulated herein. These latter experiments were conducted with fire-safe fuel (FSF) and fire-resistant hydraulic fluid (FRH) candidates. The resulting experimental data agree with flammability measurements made with laboratory and bench-scale

techniques and provide an apparently realistic assessment of ballistic vulnerability. It is planned to evaluate the realism of the ballistic exposure by arranging for a series of Army-conducted full-scale ballistic tests. Author (GRA)

**N78-31189#** Army Armament Research and Development Command, Aberdeen Proving Ground, Md. Ballistics Research Lab.
**IMPACT THRESHOLDS FOR THE INITIATION OF METAL SPARKING Final Report**
Warren W. Hillstrom Mar. 1978 36 p refs Supersedes BRL-IMR-284
(AD-A054738; AD-E430025; ARBRL-MR-02820; BRL-IMR-284) Avail: NTIS HC A03/MF A01 CSCL 11/6

Metal cylinders were projected perpendicularly against thick metal plates at varied velocities to determine thresholds of sparking. Pyrophoric metal projectiles such as cerium (misch metal), hafnium, titanium, zirconium, and aluminum (Dural) had lower thresholds than the non-pyrophoric metals - iron and copper. Empirical predictions of metal pyrophoricity were confirmed by these results. Impacts on Dural targets had higher thresholds than those on steel targets for given metal projectiles. This is attributed to the lower density of Dural. Author (GRA)

**N78-31190#** Arizona Univ., Tucson. Dept. of Chemistry.
**DEDICATED COMPUTER CONTROL OF CHEMICAL INSTRUMENTATION Final Technical Report, 1 Jun. 1971 - 30 Sep. 1977**
George S. Wilson and Michael F. Burke 1 May 1978 38 p refs
(Contract N00014-75-C-0512)
(AD-A055268; TR-12) Avail: NTIS HC A03/MF A01 CSCL 07/4

Research in the area of computer controlled instrumentation is described. This involved the development of a hierarchical computer network to acquire data and control chemical experiments. Experiments involving electrochemical generation of transient intermediates and the study of chromatographic surfaces are presented. Author (GRA)

**N78-31191#** Purdue Univ., Lafayette, Ind. Properties Research Lab.
**SPECTRAL AND TOTAL EMISSIVITY AND REFLECTIVITY AT HIGH TEMPERATURES Annual Interim Report, 1 Feb. 1977 - 31 Jan. 1978**
D. P. DeWitt, T. K. Riddle, and R. E. Taylor 23 Apr. 1978 85 p refs
(Grant AF-AFOSR-3280-77)
(AD-A055027; PRL-152; AFOSR-78-0901TR) Avail: NTIS HC A05/MF A01 CSCL 07/4

The emissometer is an extension of the multiproperty apparatus which is a powerful and unique tool for simultaneously measuring ten thermophysical properties on the same sample of an electrically-conducting solid and of studying its behavior under various environmental conditions. The apparatus features rapid time-to-temperature and data acquisition under minicomputer control yielding state-of-the-art accuracy. Performance evaluation tests of the emissometer are presented. These tests deal with veiling glare, blackbody cavity quality, and temperature distribution in the heating tube and sample. In addition spectral emissivity measurements to at least 10 micrometers have been made on tantalum (reference material), SiC, Si3N4, graphite and carbon-carbon composites from 1500 to 2400 K or their respective degradation temperatures. The new data on the ceramics provides some understanding on their high temperature behavior including the effect of fabrication process and impurities. GRA

**N78-31192#** Army Armament Research and Development Command, Dover, N. J. Large Caliber Weapon Systems Lab.
**ENGINEERING FEASIBILITY STUDY FOR ELIMINATION OF NITROGLYCERIN FROM SOLVENT VAPORS Final Report**
C. D. Mathes, J. A. Carrazza, and A. Tatyrek Mar. 1978 32 p
(AD-A055980; AD-E400124) Avail: NTIS HC A03/MF A01 CSCL 19/1

This report, based on laboratory tests, covers the evaluation of two distinct methods of separating the solvents acetone and ethyl alcohol from nitroglycerin (NG) in an air stream from a multi-base propellant-drying facility. The first method employed a semi-permeable membrane which has been used effectively to remove moisture from a gas stream. The membrane, however, did not effectively remove the NG vapor from the solvent vapors. The second method evaluated was an adsorption system using a styrene-divinylbenzene copolymer resin for separation of the NG from the solvent vapors. The resin effectively adsorbed the NG and allowed the solvent vapors to pass free of any NG contamination. The polymeric adsorbents are macroreticular ion-exchange beads without their ionic functionality, but are characterized by a spectrum of surface polarities and variety of surface areas, porosities, and pore-size distributions. These adsorbents have a relatively high thermal stability and NG adsorption capacity. Author (GRA)

**N78-31193#** Ames Lab., Iowa.
**DISTRIBUTION OF NAPHTHALENE BETWEEN COMMERCIAL RESINS AND WATER-METHANOL SOLUTIONS M.S. Thesis - Iowa State Univ.**
F. K. C. Chu Dec. 1977 32 p refs
(Contract W-7405-eng-82)
(IS-T-802) Avail: NTIS HC A03/MF A01

Several XAD resins, two of their chemically modified derivatives, and two carbon absorbents were evaluated by measurements of distribution coefficients using the batch method. Numerical comparison of distribution data and graphical interpretation of these resins were also presented. The distribution differences were explained in terms of resin structure and solvent compositions. Naphthalene was the solute for the study, and methanol the solvent. It was found that Spherocarb, a newly developed carbon adsorbent, had very large distribution coefficient. However, in the application for separation, desorption can conceivably be a problem. Distribution data collected can be a valuable aid in the choice of adsorbent, solvent composition and other operating conditions in separation work. ERA

**N78-31194#** California Univ., Los Angeles. Dept. of Chemistry.
**MULTIHETEROMACROCYCLES THAT COMPLEX METAL IONS Progress Report, 1 May 1977 - 30 Apr. 1978**
D. J. Cram 15 Jan. 1978 24 p refs
(Contract EY-76-S-03-0034-218)
(SAN-34P218X4; PR-4) Avail: NTIS HC A02/MF A01

Results are reported in a program to design, synthesize, and evaluate polycyclic host organic compounds for their abilities to complex and lipophilize guest metal ions. Work during the reporting period was devoted to synthesis and study of cyclohexametaphenylenes and cyclic phosphine oxides. ERA

**N78-31195#** Argonne National Lab., Ill.
**MAGNETIC SUSCEPTIBILITY OF AnRe2 COMPOUNDS**
M. B. Brodsky, R. J. Trainor, A. T. Aldred, and C. H. Somers 1977 9 p refs Presented at the 23d Conf. on Magnetism and Magnetic Mater., Minneapolis, 8 Nov. 1977
(Contract W-31-109-eng-38)
(CONF-771127-15) Avail: NTIS HC A02/MF A01

Measurements of magnetic susceptibilities were made from 2-300 K for the compounds AnRe2, where An = Th, U, Np, and Pu all have the MgZn2-type hexagonal Laves phase structure. Whereas ThRe2, URe2, and PuRe2 have essentially temperature-independent susceptibilities, NpRe2 is ferromagnetic with T/sub c/ = 47 K. The paramagnetic data for NpRe2 follow a modified Curie-Weiss law, chi-che sub 0 = C/(T-theta) from 60-230 K with theta = 46.9 K and C equivalent to an effective moment, P/sub eff/ = 2.11 mu/sub B/. The ordered moment mu sub 0 = 0.90 mu/sub B/ and the results are consistent with other actinide compounds having good local moment behavior. The electronic specific heat of URe2 = 34 mJ/(mole-K(2)) is large enough to indicate the possibility of spin-fluctuation behavior in this compound. ERA

**N78-31196#** Ames Lab., Iowa.
**USE OF A SEMICONDUCTOR LASER IN INFRARED SPECTROSCOPY Ph.D. Thesis - Iowa State Univ.**
R. N. Morris Dec. 1977 157 p refs
(Contract W-7405-eng-82)
(IS-T-786) Avail: NTIS HC A08/MF A01

An experiment using a semiconductor laser to continuously monitor atmospheric pollutants is described. Reproducibility and

maintenance problems are examined and the continuous monitoring capabilities of a semiconductor laser are discussed. The analytical parameters intensity, the line center, and the half width at half maximum are used to determine the concentration of the gas being monitored. Infrared absorption lines of N2O, SO2, and H2S are observed from low pressure to a total pressure of one atmosphere when mixed with room air. The analytical parameters intensity and the half width at half maximum are determined for some lines of N2O; and the line center, intensity, and the half width at half maximum are determined for several absorption lines of SO2. Also, values of the line center are obtained for several H2S absorption lines. J.M.S.

**N78-31197#** Argonne National Lab., Ill.
**MICROSCOPIC THEORY OF CHARGE DENSITY WAVE INSTABILITY IN NbSe2**
S. G. Das, S. K. Sinha, and N. Wakabayashi Feb. 1978 13 p refs Presented at a Conf. on Phonons, Paris, Sep. 1977
(Contract W-7405-eng-26)
(CONF-7709106-1) Avail: NTIS HC A02/MF A01

The microscopic theory for electronically driven lattice instabilities is used to explain the Kohn-like anomalies in the Sigma sub 1 phonon branch and the observed incommensurate superlattice Bragg peak in 2H-NbSe2, characteristics of the charge density wave at low temperatures in neutron scattering experiments. The conduction-band wave function is represented by a linear combination of tight-binding Gaussian atomic orbitals with neglect of the variation of the radical wave function across the bands. Eigenvectors for estimating electron-phonon interaction were calculated using a simple force constant model. It was found that the phonon frequencies for the Sigma sub 1 and Sigma sub 3 branches are very strongly renormalized as one approaches the zone boundary. By introducing the electronic relaxation effect the actual phonon renormalization is partially suppressed. ERA

**N78-31198#** McElroy (Ralph) Co., Austin, Tex.
**POTENTIOMETRIC TITRATION WITH EDTA USING METALLIC BISMUTH INDICATOR ELECTRODE**
Tsuyoshi Nomura and Genkichi Nakagawa Feb. 1978 13 p refs Transl. into ENGLISH from Japan Analyst (Tokyo), v. 19, no. 3, 1970 p 397-402 Presented at 10th Ann. Meeting of the Chem. Soc. of Japan, Apr. 1966 Sponsored by DOE
(ANL-Trans-1123) Avail: NTIS HC A02/MF A01

Complexometric titration of various metal cations by a potentiometric end point detection with metallic bismuth indicator electrode was studied. Bismuth electrode was prepared by electrodeposition of bismuth on a spiral wire platinum electrode from an acidic tartrate solution. The potential of the bismuth indicator electrode is expressed by the equation, E = E deg + 0.01971 log(ch173]Bi+3(ch189). ERA

**N78-31199#** California Univ., Berkeley. Lawrence Berkeley Lab.
**NUMERICAL ANALYSIS OF FLOW FIELDS GENERATED BY ACCELERATING FLAMES Ph.D. Thesis**
John Kurylo Dec. 1977 291 p refs
(Contract W-7405-eng-48; Grant DAAG29-77-G-0064)
(LBL-7233) Avail: NTIS HC A13/MF A01

A numerical technique for the analysis of nonsteady flow fields generated by accelerating flames in gaseous media is presented. The nonsteady effects on the flow field and the possible transition of the combustion process to detonation caused by an abrupt change in the burning speed of an initially steady flame propagating in an unconfined combustible gas mixture were evaluated. Optically recorded observations of accelerating flames established that the flow field can be considered to consist of nonsteady flow fields associated with an assembly of interacting shock waves, contact discontinuities, deflagration and detonation fronts. In the analysis, these flow fields are treated as spatially one-dimensional, the influence of transport phenomena is considered to be negligible, and unburned and burned substances are assumed to behave as perfect gases with constant, but different, specific heats. ERA

**N78-31200#** Wayne State Univ., Detroit, Mich. Dept. of Chemistry.
**RADIOLYSIS STUDIES ON REACTIVE INTERMEDIATES**
Larry Kevan Nov. 1977 27 p refs
(Contract EY-76-S-02-2086)
(COO-2086-88) Avail: NTIS HC A03/MF A01

A more quantitative characterization of the structure and reaction mechanism of solvated electrons produced by high energy chemistry was developed. The energy level structure of electrons in polar aqueous and alcoholic glasses was systematized from a comparison of photoconductivity and optical spectra. A laser photolysis study as a function of temperature suggests that electron solvation in ethanol glass occurs by a hindered molecular reorientation mechanism. In mixed polar and nonpolar glassy matrices, the electron is first solvated in the nonpolar matrix and is later transformed to a more stable species surrounded by the polar molecules. A recombination fluorescence experiment was devised which allows easy distinction between tunnelling and diffusive recombination mechanisms between solvate electrons and cations. ERA

**N78-31201#** Sandia Labs., Albuquerque, N. Mex.
**ACTIVATED GAS REACTIONS WITH SILICONE AND EPOXY RESINS**
N. J. DeLollis 1978 8 p refs Presented at the 23d Natl. SAMPE Symp., Anaheim, Calif., 2 May 1978
(Contract EY-76-C-04-0789)
(SAND-77-1429C; Conf-780502-3) Avail: NTIS HC A02/MF A01

The effect of argon and oxygen gas plasmas in terms of weight loss on silicone and epoxy resins is reported. The variables studied are time, pressure and power level. An RTV silicone is very stable in that it shows no weight loss under the test conditions with either oxygen or argon. An epoxy resin has significantly greater weight loss in oxygen compared to argon. When pressure is variable, weight loss peaks out at 0.7 Torr. Weight loss with increase in power level seems to be linear. A rigid aromatic amine cured epoxy tends to be more stable and loses less weight under comparable conditions than does a flexibilized polyamide cured epoxy. ERA

**N78-31202#** Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.
**FUNDAMENTAL STUDIES OF METAL FLUORINATION REACTIONS Annual Progress Report**
Robert A. Rapp, S. N. S. Reddy, S. F. Chou, and B. S. Lee Jan. 1978 47 p refs
(Contract EY-76-S-02-2671)
(COO-2671-7; APR-3) Avail: NTIS HC A03/MF A01

Results are presented of investigations of the solubility and diffusivity of fluorine in copper. Research is reported on the electronic conductivity of CaF2 electrolyte and mixed electrode reactions in solid electrolyte cells. Author (ERA)

**N78-31203#** Atlantic Richfield Hanford Co., Richland, Wash. Analytical Labs.
**DETERMINATION OF LOW-LEVEL MERCURY BY COLD VAPOR GENERATION AND ATOMIC ABSORPTION SPECTROSCOPY**
A. D. King Jun. 1977 23 p refs
(Contract EY-76-C-06-2130)
(ARH-LD-160) Avail: NTIS HC A02/MF A01

A procedure for determining mercury in liquid samples by cold vapor flameless atomic absorption spectroscopy was developed. The optimum parameter values were determined and mercury standard storage conditions investigated. The effect and tolerance levels of twenty-seven ions, including those ions common to tank farm operations and the synthetic wastes, were measured. Standard deviation for the procedure is less than 1%. The procedure can be used to determine mercury at the part per billion level in any liquid sample, a thousand-fold increase in sensitivity over current flame techniques. ERA

**N78-31204#** Little (Arthur D.), Inc., Cambridge, Mass.
**EFFECT OF HANDLING PROCEDURES ON SAMPLE QUALITY Final Report, Dec. 1976 - Nov. 1977**
J. W. Adams, T. E. Doerfler, and C. H. Summers Feb. 1978 58 p refs
(Contract EPA-68-02-2150)
(PB-279910/4; EPA-600/7-78-017) Avail: NTIS HC A04/MF A01 CSCL 07D

The effects of typical shipping and storage handling procedures on organic materials collected in Level 1 environmental assessment (EA) studies were evaluated. Parameters reviewed included: sample container composition (amber glass and high-density linear polyethylene), head space composition (air or nitrogen), temperature (38 C, 21 C, and 5 C), lighting (dark and diffuse sunlight), and catalytic species content. Three sample sets, representing fractions obtained during a Level 1 EA and containing six model organic compounds, were used. A simulated 3 week shipping and storage cycle represented elapsed time between sample collection and analysis. Analysis of variance was used to assess the relative effect of each shipping storage condition studied. GRA

**N78-31205#** Pacific Northwest Environmental Research Lab., Corvallis, Ore. Marine and Freshwater Ecology Branch.
**A USER'S GUIDE FOR REDEQLEPA. A COMPUTER PROGRAM FOR CHEMICAL EQUILIBRIA IN AQUEOUS SYSTEMS Progress Report, Jul 1975 - Jul. 1977**
Sara E. Ingle, Marcus D. Schuldt, and Donald W. Schults Feb. 1978 98 p refs
(PB-280149/6; EPA-600/3-78-024) Avail: NTIS HC A05/MF A01 CSCL 07D

A guide explaining the use of the computerized chemical equilibrium program REDEQL.EPA is presented. The program computes aqueous equilibria for up to 20 metals and 30 ligands in a system. The metals and ligands are selected from a list of 35 metals and 59 ligands for which thermodynamic data for complexes and solids were stored in a data file. More data may be added by the user. The equilibria which the program considers include complexation, precipitation, oxidation, reduction, and pH dependent phenomena. The guide allows one to use the program without reference to the FORTRAN program. The capabilities and limitations of the program are discussed. The formats for input and explanation of output are given with examples illustrating the various program options. Common user errors are discussed. GRA

# 26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

**N78-31206#** Cory Labs., Inc., Escondido, Calif.
**ENGINEERING DESIGN DATA AND CORRELATIONS FOR NITINOL DEVICES**
J. S. Cory 8 May 1978 71 p refs Backup document for AIAA Synoptic, "Nitinol Thermodynamic State Surfaces", scheduled for publication in Journal of Energy in Sep. - Oct. 1978
(Contract EC-77-X-01-4111)
Avail: NTIS HC A04/MF A01

An empirical data correlation technique, using state surfaces, which is a first step in organizing all data into standard thermodynamic form is presented. Using a specified, limited number of experimental measurements a set of state surfaces are interpolated that: (1) describe all possible thermodynamic paths for a Nitinol element and also demonstrate all of the FLT phenomena (creep, hysteresis, etc.); (2) provide a simple basis for quantitatively circumscribing and describing the effects of alloy composition, heat treatment, and cold working; and (3) provide a basis for thermodynamic calculations of predicted device performance and consequently, a basis for device design and optimization. The basic state surfaces and the techniques for obtaining and using these surfaces for prediction are described. Several examples are given to relate these surfaces to previously available material properties measurements and observed complex behavior. J.M.S.

**N78-31207#** Royal Aircraft Establishment, Farnborough (England).
**ALTERNATING TENSION-COMPRESSION FATIGUE STRENGTH AND PROPERTY CHANGES OF STEEL AFTER COLD DEFORMATION AT DIFFERENT DEFORMATION RATES**
H. R. Sander and M. Hempel Apr. 1978 75 p refs Transl. into ENGLISH from Arch. Eisenhuettenw. (West Germany), v. 23, no. 7/8, 1952 p 290-320 (RAE-Lib-Trans-1967; BR64082) Avail: NTIS HC A04/MF A01

The effect of pre-strain and the pre-straining deformation rate on the tensile and fatigue properties of a soft iron, a 0.4% C steel, a 19 Cr/7 Ni metastable austenitic steel and a 15 Cr/27 Ni stable austenitic steel were investigated. The yield stress, tensile strength and fatigue properties of the soft iron, the 0.4% C steel and the metastable austenitic steel were increased with the degree of pre-strain. For the soft iron and the 0.4% C steel a high deformation rate was found to be beneficial whereas the opposite was true for the metastable austenitic steel. The strength of the stable austenitic steel was increased with the degree of pre-strain but was independent of the deformation rate; the fatigue properties of this material were independent of both the degree of pre-strain and deformation rate. Reasons for the different behavior of these materials were studied and are discussed. Author

**N78-31208*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**INHIBITION OF HOT SALT CORROSION BY METALLIC ADDITIVES**
Daniel L. Deadmore and Carl E. Lowell Jul. 1978 20 p refs (Contract EF-77-A-01-2593)
(NASA-TM-78966; E-9725; DOE/NASA/2953-78/2) Avail: NTIS HC A02/MF A01 CSCL 07D

The effectiveness of several potential fuel additives in reducing the effects of sodium sulfate-induced hot corrosion was evaluated in a cyclic Mach 0.3 burner rig. The potential inhibitors examined were salts of Al, Si, Cr, Fe, Zn, Mg, Ca, and Ba. The alloys tested were IN-100, U-700, IN-738, IN-792, Mar M-509, and 304 stainless steel. Each alloy was exposed for 100 cycles of 1 hour each at 900 C in combustion gases doped with the corrodant and inhibitor salts and the extent of attack was determined by measuring maximum metal thickness loss. The most effective and consistent inhibitor additive was Ba (NO3)2 which reduced the hot corrosion attack to nearly that of simple oxidation. Author

**N78-31209*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**REVIEW OF THE AGARD S AND M PANEL EVALUATION PROGRAM OF THE NASA-LEWIS SRP APPROACH TO HIGH-TEMPERATURE LCF LIFE PREDICTION**
Marvin H. Hirschberg 1978 11 p refs Proposed for presentation at the 52d Meeting of the Propulsion and Energetics Panel, Cleveland, 23-27 Oct. 1978; sponsored by AGARD
(NASA-TM-78879; E-9772) Avail: NTIS HC A02/MF A01 CSCL 11F

Twenty laboratories in six countries participated in testing their own materials of interest under their own laboratory conditions. In this way the results obtained provided validation of the Strainrange Partitioning (SRP) method for a wide range of materials and insured maximum usefulness to each of the participating laboratories. The various investigators shared their findings, thus providing the basis for an in-depth evaluation of the SRP method. While the results were variable from laboratory to laboratory, most investigators agreed that the SRP method was a significant step toward life prediction in the presence of high temperature and cyclic stresses. L.S.

**N78-31210*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE EFFECT OF FUEL-TO-AIR RATIO ON BURNER-RIG HOT CORROSION**
Daniel L. Deadmore, Carl E. Lowell, and Fred J. Kohl Jul. 1978 20 p refs
(NASA-TM-78960; E-9649) Avail: NTIS HC A02/MF A01 CSCL 07A

Samples of a cobalt-base alloy, Mar M-509, were subjected to hot corrosion in a Mach-0.3 burner rig. The corrodent was NaCl added as an aqueous solution to the combustion products of a sulfur-containing Jet-A fuel. The metal temperature was fixed at 900 C. The extent of hot corrosion increased by a factor of three as the fuel-to-air mass ratio was increased from 0.033 to 0.050. Because the depositing salt was always Na2SO4,

the increased attack appeared to be related to the gas composition. Author

**N78-31211*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**LONGITUDINAL SHEAR BEHAVIOR OF SEVERAL OXIDE DISPERSION STRENGTHENED ALLOYS**

T. K. Glasgow Aug. 1978 20 p refs Proposed for presentation at the Fall Meeting of the Am. Inst. of Mining, Metallurgical and Petrol. Engr., Chicago, 24-27 Oct. 1978

(NASA-TM-78973; E-9746) Avail: NTIS HC A02/MF A01 CSCL 11F

Two commercial oxide dispersion strengthened (ODS) alloys, MA-753 and MA-754, and three experimental ODS alloys, MA-757E, MA-755E, and MA-6000E, were tested in shear at 760 C. Comparisons were made with other turbine blade and vane alloys. All of the ODS alloys exhibited less shear strength than directionally solidified Mar-M 200 = Hf or then conventionally cast B-1900. The strongest ODS alloy tested, MA-755E, was comparable in both shear and tensile strength to the lamellar directionally solidified eutectic alloy gamma/gamma prime - delta. Substantial improvements in shear resistance were found for all alloys tested when the geometry of the specimen was changed from one generating a transverse tensile stress in the shear area to one generating a transverse compressive stress. Finally, 760 C shear strength as a fraction of tensile strength was found to increase linearly with the log of the transverse tensile ductility. Author

**N78-31212*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**EFFECTS OF COMPOSITIONAL CHANGES ON THE PERFORMANCE OF A THERMAL BARRIER COATING SYSTEM**

Stephan Stecura Aug. 1978 33 p refs Proposed for presentation at the 3d Ann. Conf. on Composite and Advanced Mater., Merritt Island, Fla. 21-24 Jan. 1979

(NASA-TM-78976; E-9751) Avail: NTIS HC A03/MF A01 CSCL 11F

Currently proposed thermal barrier systems for aircraft gas turbine engines consist of NiCrAlY bond coating covered with an insulating oxide layer of yttria-stabilized zirconia. The effect of yttrium concentration (from 0.15 to 1.08 w/o) in the bond coating and the yttria concentration (4 to 24.4 w/o) in the oxide layer were evaluated. Furnace, natural gas-oxygen torch, and Mach 1.0 burner rig cyclic tests on solid specimens and air-cooled blades were used to identify trends in coating behavior. Results indicate that the combinations of yttrium levels between 0.15 - 0.35 w/o in the bond coating and the yttria concentration between 6 - 8 w/o in the zirconium oxide layer were the most adherent and resistant to high temperature cyclic exposure. Author

**N78-31213*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**EFFECTS OF THERMOMECHANICAL PROCESSING ON STRENGTH AND TOUGHNESS OF IRON - 12-PERCENT-NICKEL - REACTIVE METAL ALLOYS AT -196 C**

Joseph R. Stephens and Walter R. Witzke Aug. 1978 36 p refs

(NASA-TP-1308; E-9583) Avail: NTIS HC A03/MF A01 CSCL 11F

Thermomechanical processing (TMP) was evaluated as a method of strengthening normally tough iron-12-nickel-reactive metal alloys at cryogenic temperatures. Five iron-12 nickel alloys with reactive metal additions of aluminum, niobium, titanium, vanadium, and aluminum plus niobium were investigated. Primary evaluation was based on the yield strength and fracture toughness of the thermomechanically processed alloys at -196 C. B.B.

**N78-31214#** Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.

**PLASTICITY AND VARIABLE HEREDITY**

Erhard Krempl Feb. 1978 38 p refs

(Contract N00014-76-C-0231)

(AD-A054254; RPI-CS-78-2) Avail: NTIS HC A02/MF A01 CSCL 11/6

The operational definition of variable heredity is compared with that of rate-dependence and they are shown to be unrelated indicative that 'fading memory' and 'plasticity' do not necessarily exclude each other. The problems of characterizing materials with 'plasticity' effects are discussed. Finally, the operational definition for 'plasticity' obtained herein is applied as a necessary condition to various constitutive equations previously proposed for 'plasticity'. Some of these are shown to be unsuited for 'plasticity'. Owing to the special nature of the 'plasticity' a functional constitutive equation showing history dependence in a mathematical sense may fail to reproduce 'plasticity'. GRA

**N78-31215#** Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.

**THE CONSTANT VOLUME HYPOTHESIS FOR THE INELASTIC DEFORMATION OF METALS IN THE SMALL STRAIN RANGE**

P. Hewelt and E. Krempl Dec. 1977 14 p refs

(Contract N00014-75-C-0231)

(AD-A054253; RPI-CS-77-3) Avail: NTIS HC A02/MF A01 CSCL 11/6

In plasticity and creep theory it is generally assumed that inelastic deformations are volume preserving. Available tensile and creep tests were evaluated to see whether the experiments confirm the constant volume assumption. None of the experiments which were done on a variety of structural metals confirmed the constant volume hypothesis. Author (GRA)

**N78-31216#** Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.

**A NONLINEAR UNIAXIAL INTEGRAL CONSTITUTIVE EQUATION INCORPORATING RATE EFFECTS,CREEP, AND RELAXATION**

A. P. Cernocky and E. Krempl Feb. 1978 44 p refs

(Contract N00014-76-C-0231)

(AD-A054252; RPI-CS-78-1) Avail: NTIS HC A03/MF A01 CSCL 11/6

A previously proposed first order nonlinear differential equation for uniaxial viscoplasticity, which is nonlinear in stress and strain but linear in stress and strain rates, is transformed into an equivalent integral equation. The proposed equation employs total strain only and is symmetric with respect to the origin and applies for tension and compression. The limiting behavior for large strains and large times for monotonic, creep, and relaxation loading is investigated and appropriate limits are obtained. When the equation is specialized to an overstress model it is qualitatively shown to reproduce key features of viscoplastic behavior. These include: initial linear elastic or linear viscoelastic response, immediate elastic slope for an instantaneous change in strain rate, normal strain rate sensitivity and nonlinear spacing of the stress-strain curves obtained at various strain rates; primary and secondary creep and relaxation such that the creep (relaxation) curves do not cross. Isochronous creep curves are also considered. Other specializations yield wavy stress-strain curves and inverse strain rate sensitivity. For cyclic loading the model must be modified to account for history dependence in the sense of plasticity. Author (GRA)

**N78-31217#** California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.

**MECHANICAL STABILITY OF RETAINED AUSTENITE IN TEMPERED 9Ni STEEL**

C. K. Syn, P. Fultz, and J. W. Morris, Jr. Mar. 1978 23 p refs

(Contract N00014-75-C-0154)

(AD-A055240; TR-7) Avail: NTIS HC A02/MF A01 CSCL 11/6

The behavior of the thermally stable austenite in the ductile fracture surface layer of a grain-refined and tempered 9Ni steel broken at 77 K was studied through use of Moessbauer spectroscopy and transmission electron microscopy. Thin foils revealing the microstructural profile of the fracture surface layer were prepared by electroplating a thick pure iron layer on the fresh fracture surface, then thinning a profile sample through a combination of conventional twin-jet electropolishing and ion milling techniques. The results of both Moessbauer spectroscopy

and TEM studies showed that the thermally stable austenite transforms to a dislocated martensite in the deformed zone adjacent to the ductile fracture surface. This result suggests that transformation of the retained austenite present in tempered 9Ni steel is compatible with low temperature toughness, at least when the transformation product is a ductile martensite.
Author (GRA)

**N78-31218#** Cincinnati Univ., Ohio. Dept. of Materials Science and Metallurgical Engineering.
**PROCEEDINGS OF AFOSR/AFML CORROSION WORKSHOP Final Technical Report**
M. Hoch and J. Gwinn Oct. 1977 148 p Workshop held at Dayton, Ohio, 17-18 Sep. 1975
(Contract F33615-73-C-5084; AF Proj. 7351)
(AD-A055281; AFML-TR-77-175) Avail: NTIS HC A07/MF A01 CSCL 11/6

The first part of the proceedings contains the detailed presentations of Air Force problems related to corrosion in Aerospace Systems, given by representatives of AF Systems Command, AF Logistics Command, and AF Office of Scientific Research. The second part reports the conclusions on research needs to meet these problems in six areas: (1) Coatings and inhibitors; (2) Accelerated testing and realistic test environments; (3) Environmental effects on crack growth rates; (4) Stress corrosion cracking and hydrogen embrittlement; (5) Environmental degradation of electronic materials; and (6) New approaches to corrosion problem solving. Author (GRA)

**N78-31219#** National Bureau of Standards, Washington, D. C. Inst. for Materials Research.
**THE ROLE OF PASSIVE FILM GROWTH KINETICS AND PROPERTIES IN STRESS CORROSION AND CREVICE CORROSION SUSCEPTIBILITY Technical Summary Report, Dec. 1976 - Dec. 1977**
J. Kruger, J. R. Ambrose, J. J. Carroll, and A. J. Melmed Nov. 1977 68 p refs
(Contract NAONR-18-69)
(AD-A055366; NBSIR-78-1429; TR-8) Avail: NTIS HC A04/MF A01 CSCL 11/6

This report consists of the following four parts: Field Ion Microscopy Studies of the Interaction of Hydrogen with Selected Metals and Alloys; The Role of Noncrystalline Films in Passivation and Breakdown of Passivation; Effect of Chromium Depletion on the Repassivation Kinetics 18-10 Austenitic Stainless Steel in Sodium Chloride Solutions; and Composition of Surface Films Formed During the Repassivation of Iron and Iron-Molybdenum Alloys. Author (GRA)

**N78-31220#** Georgia Inst. of Tech., Atlanta. School of Chemical Engineering.
**CYCLIC DUCTILITY, CYCLIC STRENGTH AND FATIGUE CRACK PROPAGATION OF METALS AND ALLOYS**
Saghana B. Chakrabortty 16 May 1978 34 p refs
(Contract N00014-75-C-0349)
(AD-A055359; TR-78-2) Avail: NTIS HC A03/MF A01 CSCL 11/6

Fatigue crack propagation has been related to the cyclic stress-strain and life-strain response of materials by means of a ductility exhaustion mechanism. The da/dn-delta K relationship has been derived from the assumption that an elemental crack extension occurs when the sum of the fractional fatigue life of an element at various cycles is equal to unity. Experimental fatigue crack propagation data of representative metals and alloys have been compared with that predicted from their low cycle fatigue properties. The threshold delta K behavior has been explained in terms of the existance of a threshold plastic strain amplitude. Author (GRA)

**N78-31221#** Army Materials and Mechanics Research Center, Watertown, Mass.
**SOLIDIFICATION OF ELECTROSLAG REMELTED LOW ALLOY STEEL INGOTS Final Report**
Robert H. Frost Oct. 1977 26 p refs
(AD-A055576; AMMRC-TR-77-20) Avail: NTIS HC A03/MF A01 CSCL 11/6

The solidification of electroslag remelted AISI 4340 steel ingots was investigated over a range of melt rates from 3.7 to 6.3 lb/min. The liquid metal pool shape was determined by marking the liquidus isotherm with tungsten additions, and these data were used for an empirical model to predict the liquidus geometry as a function of the melt rate. The model is based on the premise that the solidification rate normal to the mold wall is independent of the melt rate. Data on the local solidification time and the axial mushy zone width were obtained from dendrite arm spacing measurements and an empirical relation between the arm spacings and the average cooling rate during solidification. This was combined with information on the liquidus isotherm shape to locate the solidus isotherm. The local solidification time, mushy zone width, and depth of the solidus isotherm are not linear functions of the melt rate. At a high melt rate where the liquid pool depth approaches the ingot radius the rate of increase of these variables with increasing melt rate is significant, and conditions are produced which would be expected to result in solidification-related defects such as macrosegregation. Macrosegregation was investigated by wet chemical analyses at locations from the surface to the center of the ingots. No macrosegregation was observed in the AISI 4340 alloy at either the high or low melt rate. Author (GRA)

**N78-31222#** Brookhaven National Lab., Upton, N. Y.
**CORRELATION OF LOW-CYCLE AND HIGH-CYCLE FATIGUE DATA FOR SOLUTION-ANNEALED INCOLOY-800**
P. Soo and J. G. Y. Chow 1978 6 p refs Presented at the Intern. Conf. on Alloy 800, Petten, Netherlands, 14 Mar. 1978
(Contract EY-76-C-02-0016)
(BNL-NUREG-23776; Conf-780310-1) Avail: NTIS HC A02/MF A01

High-cycle data were generated on materials test system (MTS) closed-loop electrohydraulic fatigue machines operating in the push-pull sinusoidal-load waveform mode at a frequency of 40 Hz. All tests were in air on hourglass specimens which had a minimum diameter of 0.125 inch. Three Incoloy heats were evaluated and contained the following concentrations of carbon, titanium, and aluminum: heat HH5556A-0.07 percent C, 0.42 percent Ti, 0.47 percent Al; heat HH3113A-0.06 percent C, 0.39 percent Ti, 0.36 percent Al; and heat HH7531A-0.03 percent C, 0.20 percent Ti, 0.10 percent Al. Data on the latter low-carbon heat are given for comparison only and were not included in the analysis. ERA

**N78-31223#** Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.
**HYDROGEN ATTACK OF STEEL Progress Report, 1 Apr. 1977 - 31 Mar. 1978**
P. G. Shewmon Dec. 1977 11 p ref
(Contract EY-76-S-02-2872)
(COO-2872-2) Avail: NTIS HC A02/MF A01

Carbon steels of approximately equivalent carbon content and varying mainly in the method of steelmaking, i.e., semi-killed, fully-killed, REM-treated, and electroslag refined (ESR), were studied to determine the effect of deoxidation practice and inclusion morphology on the hydrogen attack of carbon steel. Tests were run on a cold-rolled steel (to develop experimental techniques), the semi-killed, and REM-treated materials. Heat treatment for the latter two steels consisted of 60 minutes at 890 C and air cooling to give an average grain size of ASTM No. 8. Significant results are: (1) hydrogen attack results in substantial (factor of ten) greater growth normal to the rolling plane than in the rolling plane; (2) metallography and fractography show a few areas with many microscopic bubbles in the REM-treated steel indicating high bubble nucleation rates on some boundaries and much lower on most boundaries; (3) incubation times, are on the order of 4 to 5 times that predicted from Weiner's equation. ERA

**N78-31224#** Oak Ridge National Lab., Tenn.
**LITHIUM COMPATIBILITY RESEARCH: STATUS AND REQUIREMENTS FOR FERROUS MATERIALS**
J. E. Selle and D. L. Olson 1978 29 p refs Presented at the NACE meeting on corrosion, Houston, Tex., 6 Mar. 1978
(Contract W-7405-eng-26)
(CONF-780308-6) Avail: NTIS HC A03/MF A01

A brief historical review and a description of the present status of the knowledge accumulated on lithium-ferrous alloy corrosion research are presented and discussed. The effects of

various parameters are discussed and the future requirements of lithium corrosion research are included. ERA

**N78-31225#** California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
**MICROSTRUCTURE AND MAGNETIC PROPERTIES OF Fe-Cr-Co-V ALLOYS**
Y. Belli, M. Okada, G. Thomas, M. Homma (Tohoku Univ., Sendai, Japan), and M. Kaneko (Tohoku Univ., Sendai, Japan) Dec. 1977 18 p refs Presented at 23d Conf. on Magnetism and Magnetic Mater., Minneapolis, 8 Nov. 1977
(Contract W-7405-eng-48)
(LBL-6931; Conf-771127-13) Avail: NTIS HC A02/MF A01

The relationship between the microstructure and magnetic properties of heat treated Fe-23 wt percent Cr-15 wt percent Co-5 wt percent V was studied by transmission electron microscopy and Lorentz microscopy. Heat treatments used include: (1) isothermal aging; (2) TMT (thermomagnetic treatment) + step-aging; and (3) continuous cooling. The magnetic properties of the alloy were found to be very sensitive to the temperature of the thermomagnetic treatment. Step-aging gave the best magnetic properties, producing an elongated ferromagnetic phase, 300 A in diameter and 1200 A in length. Lorentz microscopy revealed domain walls which lie within the Cr-rich phase and are pinned by the Fe-rich phase in the isothermally aged alloy at 650 C. Magnetic domains of optimally step-aged alloy, 0.5 micron in width, are elongated along the direction of the applied magnetic field. The results suggest that the magnetic anisotropy is introduced parallel to the direction of the applied magnetic field during TMT and step-aging treatments. ERA

**N78-31226#** California Univ., Livermore. Lawrence Livermore Lab.
**EQUATION OF STATE OF VANADIUM**
L. Wong 4 Jan. 1978 12 p refs
(Contract W-7405-eng-48)
(UCID-17696) Avail: NTIS HC A02/MF A01

A wide range equation of state (EOS) for vanadium is presented. The generation of this EOS was of a fast response nature. That is, the data base was constructed very rapidly, the analysis was very cursory, and it was inserted into the bi-linear logorithm (BLL) EOS library in 3 to 5 days. The composite theoretical model incorporates condensed matter, ionization equilibrium, and multiphase physics. The theoretical EOS was compared with all available high temperature and high pressure data for vanadium; good agreement was obtained. The welting on the Hugoniot could be observed because the Kopyshev gamma nuclear correction was used to generate the high density region. ERA

**N78-31227#** California Univ., Berkeley. Lawrence Berkeley Lab.
**DUCTILE SUPERCONDUCTING WIRE THROUGH NOVEL METALLURGICAL TECHNIQUES**
M. Hong and J. W. Morris, Jr. Jan. 1978 7 p Presented at Workshop on the Develop. of Superconductors for Fusion Power, Germantown, Md., 26 Jan. 1978
(Contract W-7405-eng-48)
(LBL-7366; Conf-780124-2) Avail: NTIS HC A02/MF A01

Ductile superconducting wires formed through controlled precipitation of the A15 phase from supersaturated solution in the solid state. The current research focused on melting, homogenizing, and thermomechanically processing supersaturated solutions of Ga in V. A diagram of the rolling process is given. ERA

**N78-31228#** Oak Ridge National Lab., Tenn.
**STRESS-STRAIN BEHAVIOR OF ERNiCr-3 WELD FILLER METAL UNDER STRAIN CONTROLLED CYCLIC LOADING**
V. B. Baylor, M. K. Booker, J. P. Strizak, and R. L. Klueh Jan. 1978 39 p refs
(Contract W-7405-eng-26)
(ORNL-TM-6128) Avail: NTIS HC A03/MF A01

Weld filler metal ERNiCr-3 is expected to be used in the transition joints of the steam generators in breeder reactors. Design and analysis of these joints require consideration of the mechanical properties of the materials involved. Analytical representations for the cyclic stress--strain response of ERNiCr-3 as observed during strain controlled continuous cycling fatigue tests were studied. Specifically, areas discussed include cyclic hardening and softening during testing, development of cyclic stress--strain curves from stress--strain amplitude coordinates, and development of bilinear representations of cyclic stress--strain behavior as recommended for inelastic analysis by current interim inelastic design rules. The rules were originally developed for austenitic steels, but were extended here to provide a framework within which to analyze the behavior of ERNiCr-3. ERA

**N78-31229#** Sandia Labs., Albuquerque, N. Mex.
**ELEVATED TEMPERATURE CREEP AND FATIGUE DAMAGE OF A 2.25 Cr-1 Mo STEEL WELDMENT**
J. A. VanDenAvyle Jan. 1978 35 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1556) Avail: NTIS HC A03/MF A01

In weldments between dissimilar metals wide variations occur in metallurgical structure and mechanical properties, so that for good structural design it is necessary to understand the mechanical response of individual microstructural segments of the weld. Elevated temperature properties of a 2.25 Cr-1 Mo ferritic steel base metal welded with Chromenar 382V (Inconel 82) filler metal were investigated. Creep and low cycle fatigue tests at 866 K (1100 F) show the filler metal and heat affected zone to be much stronger than the base metal. Optical microscopy does not show significant aging effects in the short term fatigue tests or creep tests of 1180 hour duration. ERA

**N78-31230*#** SRI International Corp., Menlo Park, Calif.
**EPRI-NASA COOPERATIVE PROJECT ON STRESS CORROSION CRACKING OF ZIRCALOYS Final Report**
D. Cubicciotti and R. L. Jones Mar. 1978 265 p refs Sponsored by NASA
(EPRI Proj. 455-1)
(NASA-CR-157577; EPRI-NP-717) Avail: NTIS HC A12/MF A01 CSCL 11F

Examinations of the inside surface of irradiated fuel cladding from two reactors show the Zircaloy cladding is exposed to a number of aggressive substances, among them iodine, cadmium, and iron-contaminated cesium. Iodine-induced stress corrosion cracking (SCC) of well characterized samples of Zircaloy sheet and tubing was studied. Results indicate that a threshold stress must be exceeded for iodine SCC to occur. The existence of a threshold stress indicates that crack formation probably is the key step in iodine SCC. Investigation of the crack formation process showed that the cracks responsible for SCC failure nucleated at locations in the metal surface that contained higher than average concentrations of alloying elements and impurities. A four-stage model of iodine SCC is proposed based on the experimental results and the relevance of the observations to pellet cladding interaction failures is discussed. ERA

**N78-31231#** Sulzer Bros. Ltd., Winterthur (Switzerland). Konzernstabsabt. Forschung und Entwicklung.
**HIGH TEMPERATURE CORROSION MECHANICS European Concerted Action. Cost 50 - Materials for Gas Turbines. Final Report**
E. Erdoes, H. Altorfer, and E. Denzler Sep. 1977 34 p refs In GERMAN Sponsored by Schweiz. Eidgenossenschaft Original contains color photographs
Avail: NTIS HC A03/MF A01

The corrosion behavior of gas turbine alloys in sulfate melts at 900 C was investigated. Reference electrodes for alkaline and alkaline/alkaline earth sulfate mixtures were developed. After introductory work on the corrosion of pure nickel and chromium, investigations on the gas turbine alloys IN 738, IN 713 and Nimonic 105 in eutectic sodium-magnesium-calcium sulfate melts were made. Since it was found that magnesium sulfate was decomposed producing MgO, a sodium-potassium sulfate melt was used, and the Shores quick method was applied. For y alloys a logarithmic relation between material deposition and current density was found. ESA

# 27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

**N78-31232*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**POLYMERIC FOAMS FROM CROSS-LINKABLE POLY-N-ARYLENEBENZIMIDAZOLES Patent**

Edward S. Harrison (Whittaker Corp., San Diego), Chadwick B. Delano (Whittaker Corp., San Diego), and Salvatore R. Riccitello, inventors (to NASA) (Whittaker Corp., San Diego) Issued 30 May 1978 10 p Filed 26 Jul. 1976 Supersedes N76-28421 (14 - 19 p 2447) Sponsored by NASA

(NASA-Case-ARC-11008-1; US-Patent-4,092,274; US-Patent-Appl-SN-708951; US-Patent-Class-260-2.5N; US-Patent-Class-260-47CP; US-Patent-Class-260-63N; US-Patent-Class-260-78.41) Avail: US Patent Office CSCL 07D

Foamed cross-linked poly-N-arylenebinzimidazoles are prepared by mixing an organic tetraamine and an ortho substituted aromatic dicarboxylic acid anhydride in the presence of a blowing agent, and then heating the prepolymer to a temperature sufficient to complete polymerization and foaming of the reactants. In another embodiment of the process, the reactants are heated to form a prepolymer. The prepolymer is then cured at higher temperatures to complete foaming and polymerization.

Official Gazette of the U.S. Patent Office

**N78-31233*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**BORON TRIFLUORIDE COATINGS FOR THERMOPLASTIC MATERIALS AND METHOD OF APPLYING SAME IN GLOW DISCHARGE Patent**

Ronald Michael Kubacki, inventor (to NASA) (Bell and Howell, Chicago) Issued 23 May 1978 4 p Filed 17 Jun. 1977 Supersedes N77-26308 (15 - 17, p 2243) Sponsored by NASA

(NASA-Case-ARC-11057-1; US-Patent-4,091,166; US-Patent-Appl-SN-807762; US-Patent-Class-428-411; US-Patent-Class-350-165; US-Patent-Class-350-175NG; US-Patent-Class-427-40; US-Patent-Class-427-41; US-Patent-Class-427-164; US-Patent-Class-428-412; US-Patent-Class-428-422; US-Patent-Class-428-447; US-Patent-Class-428-515; US-Patent-Class-428-523; US-Patent-Class-428-538) Avail: US Patent Office CSCL 07D

Plastic surfaces can be improved physically and optically by treating them with a plasma of boron trifluoride. The trifluoride can be the sole reactant or be part of a mixture also containing an organic monomeric substance such as perfluorobutene-2 or an organosilane. The boron trifluoride-containing coating can also serve as an intermediate coating between the plastic surface and a plasma deposited organic polymer.

Official Gazette of the U.S. Patent Office

**N78-31234*#** Florida Univ., Gainesville. Center for Macromolecular Science.

**[SYNTHESIS OF THERMALLY STABLE POLYMERS] Final Report**

George B. Butler 25 Jul. 1978 82 p refs

(Grant NsG-3120)

(NASA-CR-157360) Avail: NTIS HC A05/MF A01 CSCL 07D

The reaction of bis triazo linediones with divinyl esters and substituted styrenes was investigated. Twenty new polymers were derived via reaction of two previously synthesized bis triazol linediones and four new bis atriazol linediones with eight styrenes. The structure and polymer properties of these thermally stable polymers was examined. The reaction of triazo linediones with enol esters was also considered. J.M.S.

**N78-31235*#** Ultrasystems, Inc., Irvine, Calif.

**SYNTHESIS OF PERFLUOROALKYLENE AROMATIC DIAMINES Final Report, 14 Apr. 1977 - 12 May 1978**

K. L. Paciorek, T. I. Ito, J. H. Nakahara, and R. H. Kratzer Aug. 1978 52 p refs

(Contract NAS3-20400)

(NASA-CR-159403; SN-8320-F) Avail: NTIS HC A04/MF A01 CSCL 07C

Analogues of methylene dianilines were synthesized, in which the methylene group between the two aromatic nuclei was replaced by various perfluoroalkylene linkage. The hydrolytic thermal, and thermal oxidative stabilities of PMR Polyimides derived from these diamines were determined. Three types of PMR Polyimide discs were fabricated from the dimethyl ester of 3,3', 4,4'-benzophenonetetracarboxylic acid, the methyl ester of 5-norbornene-2,3-dicarboxylic acid, and one of the following three diamines: methyl dianiline, 1,3-bis(4-aminophenyl) hexafluoropropane, and 2,2-bis(4-aminophenyl)hexafluoropropane. The polyimide based on 2,2-bis(4-aminophenyl) hexafluoropropane exhibited the best hydrolytic, thermal, and thermal oxidative stability as determined by moisture uptake and thermogravimetric analysis. Author

**N78-31236*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**EFFECT OF ATTRITION MILLING ON THE REACTION SINTERING OF SILICON NITRIDE**

T. P. Herbell, T. K. Glasgow, and H. C. Yeh (Cleveland State Univ.) 1978 21 p refs Presented at the 80th Ann. Meeting of the Am. Ceram. Soc., Detroit, 7-12 May 1978

(Contract EC-77-A-31-1040)

(NASA-TM-78965; E-9723; DOE/NASA/1040-78/2) Avail: NTIS HC A02/MF A01 CSCL 11G

Silicon powder was ground in a steel attrition mill under nitrogen. Air exposed powder was compacted, prefired in helium, and reaction sintered in nitrogen-4 v/o hydrogen. For longer grinding times, oxygen content, surface area and compactability of the powder increased; and both alpha/beta ratio and degreee of nitridation during sintering increased. Iron content remained constant. Author

**N78-31237*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**DEVELOPMENT AND EVALUATION OF ELASTOMERIC MATERIALS FOR GEOTHERMAL APPLICATIONS Annual Report, Oct. 1976 - Oct. 1977**

W. A. Mueller, S. H. Kalfayan, W. W. Reilly, and J. D. Ingham 1 Sep. 1978 60 p refs Prepared for DOE

(Contract NAS7-100)

(JPL-Pub-78-69) Avail: NTIS HC A04/MF A01 CSCL 11G

A material for a casing packer for service for 24 hours in a geothermal environment was developed by synthesis of new elastomers and formulation of available materials. Formulation included use of commercial elastomer gumstocks and also crosslinking of plastic (high Tg) materials. Fibrous reinforcement of fluorocarbon rubbers was emphasized. Organic fiber reinforcement did not increase hot properties significantly. Glass fiber reinforcement gave significant increase in tensile properties. Elongation was reduced, and the glass-reinforced composition examined so far did not hold up well in the geothermal environment. Colloidal asbestos fibers were also investigated. A few experiments with polyphenyl ether gave material with low tensile and high compression set. Available high styrene SBR compositions were studied. Work to date suggests that new synthetic polymers will be required for service in geothermal environments. G.G.

**N78-31238*#** International Harvester Co., San Diego, Calif. Solar Div.

**ADVANCED CERAMIC MATERIAL FOR HIGH TEMPERATURE TURBINE TIP SEALS Interim Technical Progress Report, Feb. 1976 - Nov. 1977**

N. G. Solomon and J. W. Vogan Jan. 1978 60 p

(Contract NAS3-20081)

(NASA-CR-135319; RDR-1831-23) Avail: NTIS HC A04/MF A01 CSCL 11B

Ceramic material systems are being considered for potential use as turbine blade tip gas path seals at temperatures up to 1370 1/4 C. Silicon carbide and silicon nitride structures were selected for study since an initial analysis of the problem gave these materials the greatest potential for development into a successful materials system. Segments of silicon nitride and silicon carbide materials over a range of densities, processed by

various methods, a honeycomb structure of silicon nitride and ceramic blade tip inserts fabricated from both materials by hot pressing were tested singly and in combination. The evaluations included wear under simulated engine blade tip rub conditions, thermal stability, impact resistance, machinability, hot gas erosion and feasibility of fabrication into engine components. The silicon nitride honeycomb and low-density silicon carbide using a selected grain size distribution gave the most promising results as rub-tolerant shroud liners. Ceramic blade tip inserts made from hot-pressed silicon nitride gave excellent test results. Their behavior closely simulated metal tips. Wear was similar to that of metals but reduced by a factor of six. Author

**N78-31239#** Naval Weapons Center, China Lake, Calif. Research Dept.

**TEMPERATURE DEPENDENCE OF THE DIELECTRIC CONSTANT OF QUARTZ POLYIMIDE, PART 2 Final Report, Feb. - Mar. 1978**

Fred C. Essig May 1978 8 p refs

(AD-A055105; NWC-TP-5983-Pt-2) Avail: NTIS HC A02/MF A01 CSCL 08/7

The dielectric constant and loss tangent of quartz polymide were measured as a function of temperature, in the presence of flowing air, up to 1000 F. No significant changes were observed as a function of temperature. The average value of the effective dielectric constant was found to be 3.05 and the loss tangent to be 0.0021 at 35 GHz. Author (GRA)

**N78-31240#** Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

**IDENTIFICATION OF WEAR PARTICLES, PART 1: PRELIMINARY INVESTIGATIONS Interim Report, 1 Mar. - 30 Sep. 1977**

H. A. Smith, P. W. Centers, and W. R. Craig Mar. 1978 38 p refs

(AD-A055126; AFAPL-TR-78-14-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 11/8

A ferrographic reaction chamber has been constructed to permit the micro chemical identification of wear debris. Techniques including temperature coloring, chemical bluing, dissolution, pretreatment and crystal formation on metal particles have been investigated as potential useful methods for identification of wear debris on ferrograms. Temperature coloring, chemical bluing and crystal formation appear to be most promising of techniques studied, and will be pursued in subsequent effort. Author (GRA)

**N78-31241#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

**AN ANALYSIS OF METALLIC GLASSES BY MOSSBAUER SPECTROSCOPY M.S. Thesis**

Terry A. Schmidt Mar. 1978 76 p refs

(AD-A055073; AFIT/GNE/PH/78M-8) Avail: NTIS HC A05/MF A01 CSCL 11/6

Several models have been used to describe the structure of iron-phosphorous-carbon amorphous alloys. In this study a twelve site substitutional solid model is used to describe the Mossbauer spectra obtained from six different metallic amorphous alloys. Spectra were obtained at room and at liquid nitrogen temperatures for the parent material, as well as for alloys containing various percentages of boron or silicon. Each spectrum is fit with a sum of Lorenzian profiles describing the twelve site model. The results indicate that the model is inadequate in fully describing the structure of the various materials. The results also indicate a difference in structure between the materials, and, in two cases, significant changes in structure with decreased temperature. Author (GRA)

**N78-31242#** California Univ., Los Angeles. School of Engineering and Applied Science.

**MCP GLASS ANALYSIS STUDIES Final Technical Report, 25 Jun. 1975 - 24 Sep. 1977**

John D. Mackenzie Nov. 1977 57 p refs

(Contract DAAG53-75-C-0222)

(AD-A055251) Avail: NTIS HC A04/MF A01 CSCL 09/1

Fourteen different commercially available glasses used in MCP production were analyzed in detail. The relevant physical, chemical and electrical properties were measured. An alternative method to fabricate MCP through a photosensitive glass was developed. Channel plates with hole diameters down to 15 microns were prepared and their secondary electron emissions measured. Author (GRA)

**N78-31243#** Dayton Univ. Research Inst., Ohio.

**SYNERGISTIC MECHANISMS OF SOLID LUBRICANTS Final Technical Report, 1 Apr. 1976 - 30 Sep. 1977**

Richard S. Harmer and Carlo G. Pantano Dec. 1977 59 p refs

(Contract F33615-76-C-5160)

(AD-A054741; UDRI-TR-77-27; AFML-TR-77-227) Avail: NTIS HC A04/MF A01

Literature pertaining to synergistic enhancement of solid film lubricants by additions of non-lubricant phases is reviewed. Research directed toward identification of mechanisms by which $Sb_2O_3$ additives enhance $MoS_2$ lubrication is described. Chemical, mechanical, and tribochemical reactions are investigated. Preliminary data indicates $Sb_2O_3$ alters the oxidation behavior of $MoS_2$. An experimental test apparatus for solid lubricant evaluation is described. Author (GRA)

**N78-31244#** Case Western Reserve Univ., Cleveland, Ohio. Dept. of Macromolecular Science.

**INFRARED STUDIES OF THE SOLID STATE POLYMERIZATION OF DIACETYLENE MONOMERS Technical Report, 1 Mar. 1977 - 1 Mar. 1978**

Asis Banerjie 21 Mar. 1978 97 p refs

(Contract N00014-77-C-0213)

(AD-A055988; TR-1) Avail: NTIS HC A05/MF A01 CSCL 07/3

Spectroscopic investigation of substituted conjugated diacetylenes and polyacetylenes dates back to the 1920's. However, detailed investigation of the solid state polymerization of many of these conjugated diacetylenes is more recent. Single crystals of many of these diacetylene monomers can be polymerized by the action of: (1) thermal annealing; (2) light (u.v. irradiation); (3) ionizing radiation; and (4) mechanical sheer. GRA

**N78-31245#** Army Armament Research and Development Command, Dover, N. J. Large Caliber Weapon Systems Lab.

**FEASIBILITY OF USING FLUORESCENT MATERIALS IN PRODUCT ASSURANCE APPLICATIONS AND FOR LOCATING ADHESIVE BOND FRACTURES**

Carolyn A. L. Westerdahl and J. Richard Hall Mar. 1978 27 p refs

(AD-A055979; AD-E400115; ARLCD-MR-77006) Avail: NTIS HC A03/MF A01 CSCL 13/8

A number of adhesives, coatings, polymers, fluorescent pigments, brighteners, and solvents were surveyed to determine if they are fluorescent, and if so, which wavelengths of light excite them and at which wavelength they emit light. Practical uses of fluorescence are catalogued. The advantages of using fluorescent examination are shown and suggestions are made for its use in quality control applications and in investigating failed adhesive bonds. Author (GRA)

**N78-31246#** California Univ., Berkeley. Dept. of Chemical Engineering.

**STRAIN INDUCED PLASTIC-TO-RUBBER TRANSITION OF AN SBS BLOCK COPOLYMER AND ITS BLEND WITH PS**

J. Diamant, M. Shen, T. Hashimoto, M. Fujimura, and K. Saijo 1 Apr. 1978 36 p refs

(Contract N00014-75-C-0955)

(AD-A055905; TR-19) Avail: NTIS HC A03/MF A01 CSCL 11/9

The strain softening phenomenon in poly(styrene-b-butadiene-b-styrene) and its blends with polystyrenes were investigated by means of electron microscopy and small angle X-ray scattering. Samples were cast from mixed solvents of tetrahydrofuran and methyl ethyl ketone (90/10 by volume). The structure of these samples consist of randomly oriented alternating lamellar domains of the two components. Their mechanical behavior is plastic-like in that they exhibit yielding and necking when first stretched to around 200%. After the necking has propagated throughout, the samples show typical rubber-like behavior. This phenomenon may be called the strain induced plastic-to-rubber transition, and is believed to occur as a result of structural changes from alternating

lamellar domains to fragmented PS domains dispersed in a PB matrix. GRA

**N78-31247#** Bendix Corp., Kansas City, Mo.
**SYNTACTIC FOAM FROM SILVER COATED MICROBUBBLES**
H. M. McIlroy Feb. 1978 22 p refs
(Contract EY-76-C-04-0613)
(BDX-613-1790-Rev) Avail: NTIS HC A02/MF A01

A low density syntactic foam made from a blend of a polyimide resin and silver coated glass microbubbles was evaluated. Foams prepared from the silver coated glass microbubbles have more than twice the thermal conductivity of foams made from uncoated glass microbubbles, but the value is about 10 percent less than the measured thermal conductivity of carbon microbubble foams. ERA

**N78-31248#** Bendix Corp., Kansas City, Mo.
**INVESTIGATION OF METHYLPENTENE POLYMER (CPX) MOLDING RESIN Final Report**
C. L. Walter Mar. 1978 22 p ref Revised
(Contract EY-76-C-04-0613)
(BDX-613-1905-Rev) Avail: NTIS HC A02/MF A01

A polymethylpentene polymer (TPX) produced in Japan was evaluated and compared to a TPX obtained from England. The rheological chemical and physical properties of the materials were compared and the two materials were found to be essentially identical. ERA

**N78-31249#** Bendix Corp., Kansas City, Mo.
**MATERIAL EVALUATION OF POLYURETHANE FOAM, 0.05 g/cm3 DENSITY**
J. R. Fender Mar. 1978 57 p
(Contract EY-76-C-04-0613)
(BDX-613-1836-Rev) Avail: NTIS HC A04/MF A01

Rigifoam 6003-2, a CO2 blown polyester polyurethane foam system, was chosen for use as the prime material for production of parts with a foam density of 0.05g cu cm. Studies of the 6003-2 physical properties, chemical analysis, dimensional stability, moisture content, and the machining and gaging capabilities of this material are summarized. ERA

**N78-31250#** Bendix Corp., Kansas City, Mo.
**MECHANICAL PROPERTIES OF 0.2 g/cm3 POLYSTYRENE BEAD FOAM**
D. J. Fossey Jan. 1978 23 p refs
(Contract EY-76-C-04-0613)
(BDX-613-1725-Rev) Avail: NTIS HC A02/MF A01

In order to better interpret the results from a strain gage investigation of the effects of stress induced by polystyrene bead foam (PSBF) on electronic devices, the tensile and compressive properties of 0.2 g cu cm potting PSBF were determined. These data are also required for mathematical models employed to predict the force PSBF may exert on components. The properties were determined to be a function of temperature and residual pentane (blowing agent) content at -54, 25, and 74 C. Both as-molded pentane content (1.4%) and heat aged pentane content (less than 0.2%) were evaluated. Five specimens were tested at each condition. The material evaluated was BF-61 expandable polystyrene bead, and was molded to simulate the foam used for potting electronic components. ERA

**N78-31251#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Verbundwerkstoffe.
**THE INFLUENCE OF THE ENVIRONMENT ON THE ELASTOPLASTIC PROPERTIES OF ADHESIVES IN METAL BONDED JOINTS**
Walter Althof, Gerhard Klinger, Gerhard Neumann, and Johanna Schlothauer 8 Mar. 1978 82 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-521)
(DLR-FB-77-63) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 43,40

The shear modulus, the stress at 1% shear-strain, the fracture strength, the strain at fracture and the appertaining shear stress-strain diagrams were analyzed for 10 aircraft structural adhesives. The values were calculated from the measured load deformation behavior of the adhesives in the bond line of lap joints with a thick adherend and a small overlap length, as well as from the torsion pendulum testing (DIN 53 445) of cast adhesives. The measurements were made before and after a long exposure to heat, cold, moisture, heat combined with moisture, and changes between cold and combined heat and moisture. The environmental effects on the adhesion between adherend and adhesives as observed in the tests are described. Author (ESA)

**N78-31252#** Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.
**PROTON AND ELECTRON IRRADIATION OF THERMAL CONTROL COATINGS AND POLYMERIC FILMS. PART 1: EXPERIMENTAL PART Final Report [IRRADIATIONS PAR PROTONS ET IRRADIATIONS PAR ELECTRONS DES REVETEMENTS DE CONTROLE THERMIQUE ET DE FILMS POLYMERIQUES. TOME 1 - PARTIE EXPERIMENTALE.]**
A. Paillous, M. T. Amat, J. Marco, and G. Panabiere Paris ESA Sep. 1977 106 p refs In FRENCH 2 Vol.
(Contract ESTEC-2838/76-NL-HP(SC))
(ESA-CR(P)-1077-Vol-1) Avail: NTIS HC A06/MF A01

A theoretical study based on literature results has shown that the variation of the optical absorption coefficient of certain thermal control coatings under special radiation conditions is a direct function of the average value of the energy dosage absorbed in the degraded layer of the material. An experimental program was set up to confirm these results. The spectral degradations of the reflection factors of coatings irradiated with 210, 80 and 40 keV electrons and with 150, 75 and 45 keV protons are presented. The materials studied are Kapton and alunimized Teflon, the white paints PSG 120 and PSZ 184, polyethylene terephthalate, a silicon dioxide sheet, and various other polymeric films. ESA

**N78-31253#** Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale
**PROTON AND ELECTRON IRRADIATION OF THERMAL CONTROL COATINGS AND POLYMERIC FILMS. PART 2: THEORETICAL PART Final Report [IRRADIATIONS PAR PROTONS ET IRRADIATIONS PAR ELECTRONS DE REVETEMENTS DE CONTROLE THERMIQUE ET DE FILMS POLYMERIQUES. TOME 2 - PARTIE THEORIQUE.]**
J. Bourrieau Paris ESA Feb. 1978 80 p refs In FRENCH 2 Vol.
(Contract ESTEC-2838/76-NL-HP(SC))
(ESA-CR(P)-1077-Vol-2) Avail: NTIS HC A05/MF A01

Mathematical models for the degradation of thermal control coatings by irradiation with charged particles are described and the results obtained by irradiating various materials with low energy protons and electrons are given. The models are based on the hypothesis that solar reflectance variations are induced by color centers of which the concentration in the irradiated zone depends only on the dosage. This hypothesis was verified. The sensitivity curves (variation of the optical absorption coefficient with the dosage) were recorded for Teflon, Kapton and the paints PSZ 184; the optical thickness of the latter was also obtained. The sensitivity curves of Terphane depend on the energy and the nature of the particles; a threshold reaction is probable. ESA

**N78-31254#** National Bureau of Standards, Washington, D. C.
**DEVELOPMENT OF A DATA BASE FOR ASSESSING PLASTIC FIRE HAZARDS**
James A. Slater Apr. 1978 39 p refs Sponsored in part by Consumer Product Safety Commission, Wash., D. C.
(PB-280027/4; NBSIR-78-1422) Avail: NTIS HC A03/MF A01 CSCL 11I

A data base of residential fire accidents developed to assess some of the real-life hazards associated with fire incidents involving plastics is described. The data consists of detailed case history reports based on a questionnaire form developed at the National Bureau of Standards and laboratory tests of samples retrieved at the fire scene. The major criteria for a fire incident included in the data base are that an identifiable plastic product played a significant role in the fire and the sequence of events can be partially reconstructed. Information is collected about the building

environment in which the fire occurred, the products and the persons involved in the incident, and the fire development and extinguishment. Sample tabulations of field and laboratory data from the first 25 accident cases are shown. GRA

# 28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

**N78-31255*** National Aeronautics and Space Administration. Pasadena Office, Calif.
**NITRAMINE PROPELLANTS Patent**
Norman S. Cohen (JPL) and Leon D. Strand, inventors (to NASA) (JPL) Issued 30 May 1978 8 p Filed 16 May 1977 Supersedes N77-25346 (15 - 16 p 2112) Sponsored by NASA
(NASA-Case-NPO-14103-1; US-Patent-4,092,188; US-Patent-Appl-SN-797210; US-Patent-Class-149-19.4; US-Patent-Class-149-19.8; US-Patent-Class-149-88; US-Patent-Class-149-92; US-Patent-Class-149-93; US-Patent-Class-149-105; US-Patent-Class-149-111) Avail: US Patent Office CSCL 21I

Nitramine propellants without a pressure exponent shift in the burning rate curves are prepared by matching the burning rate of a selected nitramine or combination of nitramines within 10% of burning rate of a plasticized active binder so as to smooth out the break point appearance in the burning rate curve. Official Gazette of the U.S. Patent Office

**N78-31256#** Naval Weapons Center, China Lake, Calif.
**ANTIMISTING FUEL SPILLAGE/AIRSHEAR TESTS AT NAVAL WEAPONS CENTER Final Report, Sep. 1975 - Dec. 1977**
Anthony SanMiguel and Marion D. Williams Mar. 1978 36 p refs Original contains color illustrations
(Contract DOT-FA76WAI-589)
(AD-A056113; FAA-RD-78-50) Avail: NTIS HC A03/MF A01 CSCL 21/2

A test apparatus consisting of a large scale airfoil located within a temperature-velocity-controlled air stream was used to evaluate the fire suppression afforded by FM9 antimisting fuel additive in Jet A. A homogeneous low turbulence air stream between 100 and 170 knots was used to obtain crash-survivable antimisting fuel kinematic data. It was demonstrated that FM9 could be an effective antimisting agent. The failure envelope for FM9 in 27 C Jet A fuel was measured for agent concentrations from 0.3 to 0.5 percent and 32 C air flow velocities between 100 and 170 knots. Author

**N78-31257#** Naval Weapons Center, China Lake, Calif.
**CONVERSION OF TRASH TO GASOLINE Summary Report, 1974 - 1977**
James Diebold and Garyl Smith Apr. 1978 26 p refs
(Contract EPA-IAG-D7-0781)
(AD-A055113; NWC-TP-6022) Avail: NTIS HC A03/MF A01 CSCL 07/1

This report describes a thermochemical process through which organic waste materials found in municipal trash are converted into a high grade gasoline product. The process involves three major steps: selective pyrolysis to form gases relatively rich in olefins such as ethylene, propylene, and butylene; compression and purification of the pyrolysis gases to concentrate the olefins; and polymerization of the olefins to form polymer gasoline. Pyrolysis experimentation has resulted in about half of the energy in the organic feed being found in the gaseous olefin pyrolysis product. Polymerization of pure ethylene has produced a synthetic crude oil product containing about 90% gasoline having an unleaded motor octane of 90. Preliminary economic evaluation has shown the process to be suitable for relatively small plant sizes. The projected yield of gasoline and oils is about 0.19 l/kg (46 gal/ton). The process is currently in the bench-scale development stage. Author (GRA)

**N78-31258#** Hazards Research Corp., Denville, N. J.
**DEVELOPMENT OF AN EXPLOSIVE SLURRY MONITOR**
Richard J. Henry and Milton Roth Dover, N. J. Army Armament Research and Development Command Dec. 1977 36 p
(Contract DAAA21-74-C-0365; DAAA21-75-C-0104)
(AD-A054736; AD-E400039; ARLCD-TR-77053) Avail: NTIS HC A03/MF A01 CSCL 13/2

An environmentally acceptable method of disposing of waste explosive material involves wet-grinding the material and pumping the resulting slurry into an incinerator where it is burned. For safety and economy, the homogeneity of the slurry must be maintained at a specified concentration. Therefore, the mixture must be monitored as it flows in a 9 millimeter pipe. Such a monitoring requirement is not satisfied by any commercially available instruments. A monitoring system using a bifurcated fiber-optic probe has been developed and tested. Various typical concentrations of several materials gave useable response levels, and a number of abnormal conditions (simulated in the tests) were detected. Author (GRA)

**N78-31259#** Army Armament Research and Development Command, Dover, N. J. Large Caliber Weapon Systems Lab.
**DETERMINATION OF MINIMUM NON-PROPAGATION DISTANCE OF ALUMINUM BUCKETS CONTAINING 15 POUNDS OF COMPOSITION A5**
William M. Stirrat and Richard M. Rindner Feb. 1978 30 p refs
(AD-A054737; AD-E400087; ARLCD-TR-78006) Avail: NTIS HC A03/MF A01 CSCL 19/1

A series of tests was conducted to establish the minimum non-propagation distance between adjacent aluminum buckets containing 6.8 kilograms (15.0 pounds) of Composition A5. The buckets were suspended from a pendant-type conveyor within a covered ramp. This effort was in direct support of the modernization of the Milan Army Ammunition Plant, Tennessee, but also applies to other similar facilities. The test results indicate that the minimum non-propagation distance is 6.1 meters (20.0 feet). The tests also demonstrated that buckets with covers will produce higher donor blast outputs than buckets without covers.
Author (GRA)

**N78-31260#** Army Armament Research and Development Command, Dover, N. J. Large Caliber Weapon Systems Lab.
**CRITICAL DEPTH TESTS OF BULK TNT FLAKE EXPLOSIVE Final Report**
William M. Stirrat and Richard M. Rindner Jan. 1978 34 p refs
(AD-A054739; AD-E400065; ARLCD-TR-78003) Avail: NTIS HC A03/MF A01 CSCL 19/1

A series of propagation tests was conducted with a commercially available (serpentix), corrugated, rubber belt conveyor containing bulk TNT flake explosive. Tests were performed to determine whether this conveyor could safely transport the explosive at a critical depth of 38 mm (1.5 in.). Test results indicated that the 0.61-meter (2 FT) wide serpentix conveyor, with a 25 mm (1.0-in.) minimal separation of explosive between troughs, could prevent detonation propagation. GRA

**N78-31261#** Defense Intelligence Agency, Washington, D.C.
**HYDROGEN TECHNOLOGY, FOREIGN**
James D. Busi Jun. 1978 103 p refs Supersedes DST-1850S-522-76
(AD-A055024; DST-1850S-522-78; DST-1850S-522-76) Avail: NTIS HC A06/MF A01 CSCL 21/4

Molecular hydrogen has the long-range capability of being a fuel and an efficient 'energy carrier' (a medium for transporting chemical and/or electrical energy); however, hydrogen is not a primary energy source since it is dependent upon other energy sources for its actual production. In general these dependent energy sources are thermal energy, electrical energy, and radiant energy. Because of hydrogen's specific chemical and physical properties, its more immediate applications are for aviation fuels, industrial chemical production, industrial and domestic heating, off-peak energy storage, electrical and thermal energy transmission, reduction of metal ores, and synthetic food production. Automotive applications employing hydrogen as a fuel are hindered by its poor volumetric energy storage density. The high cost of hydrogen (about $2.14/GJ (1977 dollars US)) will prevent its

use as standard fuel in the near future. Other synthetic fuels derived from advanced coal-gasification processes or fermentation of organic matter for the production of synthetic natural gas (SNG) or alcohols (Methanol and ethanol) presently appear more practical, and are receiving greater foreign and domestic funding. The greatest impact of hydrogen will be on the future international energy policy of the United States. By reducing a country's dependency on imported energy, hydrogen can greatly affect its military capability and socioeconomic stability. The pendulum is presently swinging towards hydrogen acceptance in industrialized countries dependent upon imported energy resources such as Japan, France, West Germany, and Italy. Significant hydrogen research programs presently exist in these Western countries. GRA

**N78-31262#** Mississippi Univ., University.
**AN INVESTIGATION OF HIGH PRESSURE GASEOUS INJECTIONS INTO LIQUID PROPELLANTS Final Report, 1 Jan. 1977 - 28 Feb. 1978**
C. R. Wimberly 1 May 1978 50 p refs
(Grant DAAC29-77-G-0050)
(AD-A055989; ARO-14673.1-R-E) Avail: NTIS HC A03/MF A01 CSCL 19/1

It has been recognized for many years that liquid propellants (LP) offer several advantages over solid propellants when applied to guns. One of the concerns has been the repeatability of the pressure-time curves in the chamber, and occasional high pressure values that could exceed design limits of the casing. It is apparent that several variables may be involved and that the LP is extremely sensitive to small changes in conditions at ignition and in the LP chamber. It was the attempt of the work reported here to provide more information on the ignition phase of the LP gun system operation. Simulation of the penetration sequence for gaseous injections into liquid propellants provided greater understanding of the significance of geometry and flow conditions on gas bubble formation, penetration depth and rate. Comparisons of test data and a simulation model indicated that the model is good to excellent in predicting the penetration depth and rate of the injection for the first 500 microseconds. The shape of the bubble obtained experimentally approached closely a prolate spheroid. Author (GRA)

**N78-31263#** Army Armament Research and Development Command, Dover, N. J. Large Caliber Weapon System Lab.
**INVESTIGATION OF PROPELLANT AND EXPLOSIVE SOLID SOLUTION SYSTEMS II X-RAY STUDIES**
Scott I. Morrow, Joseph J. Campisi, and Arthur J. Bracuti Mar. 1978 33 p refs
(AD-A055981; AD-E400125) Avail: NTIS HC A03/MF A01 CSCL 19/1

Debye Scherrer and diffractometer powder techniques were used to characterize isomorphous oxidizer solid solutions. Those involved were: AP-KP, AN-AP, AN-3KN.AN, KN-3KN.AN, and AN-KP. In most cases we showed that the X-ray powder patterns were different from physical mixtures with the same relative amounts of constituents. Observations were made on the shift of major diffraction lines with introduction of an isomorphous oxidizer component into another oxidizer host crystal. The X-ray powder patterns helped to illustrate the unique nature of the solid solutions involved. Some theoretical speculation was made on the possibility of the existence of superstructure in such materials, particularly the AP-KP solid solutions. Author (GRA)

**N78-31264#** Army Armament Research and Development Command, Dover, N. J. Product Assurance Directorate.
**PROPELLANT REASSESSMENT PROGRAM**
Gayton Silvestro Mar. 1978 25 p
(AD-A055976; AD-E400108) Avail: NTIS HC A02/MF A01 CSCL 19/1

As part of the Ammunition Stockpile Reliability Program (ASRP), a number of stockpiles propellant lots were reassessed for end-item use under the Propellant Reassessment Program. A sequence of laboratory and ballistic testing was developed to aid in the evaluation of these propellants. The evaluations were made with respect to the safety and performance of the propellant. Based on the propellant reassessments, disposition of 46 stockpiles propellant lots was recommended. Storage controls were developed for incorporation into the propellant stockpile system. As a result of the first 18 months of the program, propellant reassessments have directly provided a cost avoidance, in ballistic test costs for the Government, of $384,000. Author (GRA)

**N78-31265#** Kanner (Leo) Associates, Redwood City, Calif.
**PRODUCTION METHOD FOR HYDROGEN BY THERMO-MECHANICAL DECOMPOSITION OF WATER**
Honda Takashi 1977 18 p Transl. into ENGLISH from Japanese Patent Disclosure, no. 51-9093
(Contract W-7405-eng-36)
(LA-tr-77-52) Avail: NTIS HC A02/MF A01

Triiron tetroxide and hydrogen are generated by thermal decomposition of ferrous hydroxide or from the reaction of water and ferrous oxide. The generated triiron tetroxide is caused to react with hydrogen halide or ammonium halide to obtain ferrous halide and halogen gas as well as ammonia gas. In cases when ferric halide is generated as a by-product, it is thermally decomposed to become ferrous halide and halogen gas. The ferrous halide is caused to react with alkali to obtain ferrous hydroxide or ferrous oxide as well as halide of alkali or the substance decomposed from this. The halogen gas is caused to react with either metallic oxide, with carbonate or with nitrate to generate oxygen. Alkali is regenerated from the reaction by-products by well known methods. ERA

**N78-31266#** California Univ., Livermore. Lawrence Livermore Lab.
**CHARACTERIZING HIGH-ENERGY-FORMED PARTICULATES WITH THE SCANNING ELECTRON MICROSCOPE/ ENERGY DISPERSIVE SPECTROMETER SYSTEM Progress Report, Mar. 1977 - Sep. 1977**
A. W. Casey and A. H. Biermann 7 Dec. 1977 36 p
(Contract W-7405-eng-48)
(UCID-17652) Avail: NTIS HC A03/MF A01

A method is being sought that will allow the differentiation between particulates formed in implosions and particulates formed in explosion. The scanning electron microscope and energy dispersive X-ray analysis were used to measure and compare particle size, shape, surface morphology, and composition. Implosion and explosion detonations yielded spherical, smooth particles within the same size range. Although the particle size, shape, and morphology were the same for comparable samples of different detonation type, there were distinct differences in composition. It is not certain whether differences in composition reflect differences in device components for differences in the nature of the detonation (implosion or explosion). ERA

**N78-31267#** Los Alamos Scientific Lab., N. Mex.
**HIGH-TEMPERATURE SHOCK INITIATION OF EXPLOSIVES**
J. B. Ramsay, B. G. Craig, and J. J. Dick Mar. 1978 20 p refs Sponsored in part by Air Force Armaments Testing Lab.
(Contract W-7405-eng-36)
(LA-7158) Avail: NTIS HC A02/MF A01

The detonation sensitivity to plane shockwave loading of three polycrystalline, high-density explosives (PBX-9501, DATB, and TNT) was measured for runs-to-detonation up to 2.5 cm in the temperature range 25 to 150 C. Streak camera recording was used to obtain the shock-wave propagation distance, the initial shock velocity in the explosive, and the free surface velocity of the driver. For PBX-9501 and DATB no significant change in distance-to-detonation was detected between 25 and 100 C, whereas a decrease in the distance-to-detonation of approximately 30% for the same input pressure was noted for shots fired at 150 D. A small decrease in distance-to-detonation was noted for cast TNT between 25 and 73 D. The time-to-detonation for liquid TNT at 150 D for an input shock strength of 13 GPa was measured. Possible mechanisms leading to increased sensitivity in polycrystalline explosives at high temperature are discussed. ERA

**N78-31268#** Open Univ., Milton (England). Energy Research Group.
**THE RELATIVE COSTS OF PRODUCING SYNCRUDE FROM OIL SHALES OF VARIOUS GRADES UNDER VARYING CONDITIONS**
D. F. Hemming Jan. 1978 49 p refs

(ERG-022) Avail: NTIS HC A03/MF A01; Secr., Energy Res. Group, Walton Hall, Milton Keynes, Engl.

The cost of producing syncrude from oil shales using underground mining and surface retorting and open-pit mining and surface retorting are analyzed. The sensitivity of the calculated cost of production of syncrude to the estimated capital cost of plant and facilities is discussed. The effect on the cost on syncrude production of a labor rate related to the cost of syncrude is also considered. Appendices cover the energy and labor requirements of producing syncrude from oil shales in various ways. ESA

# 31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

**N78-31269#** Toronto Univ. (Ontario). Inst. for Aerospace Studies.

**SINGLE AND DUAL AIR CURTAIN JETS USED AS PROTECTION AGAINST PRECIPITATION**

S. Raimondo and A. A. Haasz Jun. 1978 96 p refs (UTIAS-227; CN-ISSN-0082-5255) Avail: NTIS HC A05/MF A01

Experimental and theoretical simulations of single and dual air-curtain jet roofs were performed in order to determine their effective protection against precipitation. The wind tunnel experiments, with glass beads used as precipitation material, yielded results which led to the conclusion that Froude scaling of the terminal velocities of the particles is not a sufficient criterion for proper simulation, and one must also match the model and full-scale precipitation Reynolds numbers. Computer simulations of full-scale air-curtain installations were performed in which the modelling of natural rain included realistic raindrop diameter distributions, drag coefficients for deformable drops and breakup of water drops. Both wind tunnel experiments and computer results indicate that the single jet configuration provided for the most part better protection against precipitation than the equivalent (having same energy, momentum and mass flow rate at exit) separated dual jets. Author

**N78-31270#** Michigan Univ., Ann Arbor. Dept. of Naval Architecture and Marine Engineering.

**A NEW METHOD FOR SOLVING SURFACE-PIERCING-STRUT PROBLEMS Interim Report, 1 Oct. 1974 - 1 Oct. 1976**

Toshimitsu Kaiho Feb. 1978 67 p refs (Contract N00014-75-C-0366) (AD-A055078; Rept-196) Avail: NTIS HC A04/MF A01 CSCL 13/10

The problem of a potential flow around a surface-piercing strut at a high Froude number is proposed. The strut can be of asymmetric cross-section and is not necessarily slender. The exact boundary-value problem is formulated and is approximated by a mathematical model which satisfies the linearized free-surface boundary conditions on the undisturbed free-surface and the rigid-body boundary condition on the actual surface of the strut. It is found that the problem can be broken into two parts, one of which is the conventional infinite-fluid problem, the other a problem which can be formulated as a two-dimensional unsteady-flow problem. The results calculated predict a significant change of the wave pattern on the suction side of the strut as the aspect ratio changes. The present method can be applied for prediction of the bow wave. The numerical calculation is performed for a double-wedge-shaped model used by Standing (1974). The calculated bow wave pattern shows good agreement with the corresponding experimental result. GRA

**N78-31271#** Pennsylvania State Univ., University Park. Applied Research Lab.

**INITIAL INVESTIGATION OF STATIONARY HYDROFOIL CAVITATION AND CAVITATION NOISE SCALING**

D. E. Thompson and M. L. Billet 16 Dec. 1977 74 p refs (Contract N00017-73-C-1418) (AD-A055260; TM-77-327) Avail: NTIS HC A04/MF A01 CSCL 13/10

A series of experiments were conducted in order to determine scaling laws for sheet type surface cavitation and the resulting noise. Four geometrically similar 10.6 percent thick symmetrical Joukowski hydrofoils with chord lengths of 1.5, 3, 6, and 12 inches were tested. Pressure distributions on the two largest hydrofoils were measured at several angles of attack. All noise measurements were made at an attack angle of 70 to produce the desired sheet cavitation. Desinent cavitation numbers were obtained as a function of velocity for each hydrofoil at several angles of attack. The noise resulting from various amounts of cavitation on each hydrofoil was measured. The amount of cavitation was determined by the ratio of cavity length (L) to chord length (c). The relative length (L/c) was varied from zero to one-third. Noise measurements included directivity patterns and spectra. The variation of cavitation noise with cavitation number, velocity, and Reynolds number was determined. Author (GRA)

**N78-31272#** Bendix Corp., Kansas City, Mo.

**DEVELOPMENT OF PLATING THICKNESS STANDARDS Milestone Report**

R. J. Russell Jan. 1978 24 p refs Revised (Contract EY-76-C-04-0613) (BDX-613-1709-Rev) Avail: NTIS HC A02/MF A01

Standards which are unavailable from the National Bureau of Standards were developed to support the nondestructive measurement of plating thickness. Their fabrication, measurement, certification, and calibration-recall schedule are discussed. Reference standards that have been put into service include aluminum/Kapton, silver/copper, tin/steel, gold/silver, cadmium/Kovar, silver/iron, rhodium/copper, and gold/ceramic. ERA

**N78-31273#** Westinghouse Electric Corp., Pittsburgh, Pa. Fusion Power Systems Dept.

**CRYOGENIC RECOVERY ANALYSIS OF FORCED FLOW SUPERCRITICAL HELIUM COOLED SUPERCONDUCTORS**

A. Y. Lee Aug. 1977 27 p refs Presented at Cryogenic Engr. Conf., Boulder, Colo., 2 Aug. 1977 (Contract W-7405-eng-26) (WFPS-TME-039; Conf-770801-26) Avail: NTIS HC A03/MF A01

A coupled heat conduction and fluid flow method of solution was presented for cryogenic stability analysis of cabled composite superconductors of large scale magnetic coils. The coils are cooled by forced flow supercritical helium in parallel flow channels. The coolant flow reduction in one of the channels during the spontaneous recovery transient, after the conductor undergoes a transition from superconducting to resistive, necessitates a parallel channel analysis. A way to simulate the parallel channel analysis is described to calculate the initial channel inlet flow rate required for recovery after a given amount of heat is deposited. The recovery capability of a NbTi plus copper composite superconductor design is analyzed and the results presented. If the hydraulics of the coolant flow is neglected in the recovery analysis, the recovery capability of the superconductor will be over-predicted. ERA

**N78-31274#** National Technical Information Service, Springfield, Va.

**ARCHITECTURAL CONSTRUCTION MATERIALS. PART 2, VOLUME 2: CONCRETES AND CEMENTS. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, Jun. 1976 - Apr. 1978**

Guy E. Habercom, Jr. Jun. 1978 205 p Supersedes NTIS/PS-77/0469; NTIS/PS-76/0377; NTIS/PS-75/390 (NTIS/PS-78/0527/8; NTIS/PS-77/0469; NTIS/PS-76/0377; NTIS/PS-75/390) Avail: NTIS HC $28.00/MF $28.00 CSCL 13C

Concrete/cement construction materials for architectural applications are investigated in these research reports. Structural design and performance are reviewed. Studies for bridges, pavements, airfields, cold weather construction are excluded. GRA

**N78-31275#** North Carolina State Univ., Raleigh. Highway Research Program.

**PAVEMENT DESIGN MANUAL FOR SECONDARY ROADS IN NORTH CAROLINA Final Report**

Bobby D. Barnes Aug. 1977 34 p
(PB-280971/3; ERSD-110-75-3) Avail: NTIS HC A03/MF A01 CSCL 13B

A procedure for design of new low volume secondary roads and overlays relies on data obtained from soil surveys published by the U.S. Department of Agriculture rather than conventional field testing. The design method generally follows accepted thickness design techniques currently recognized by the North Carolina Department of Transportation. GRA

**N78-31276#** Washington State Univ., Pullman.
**OPTIMIZATION AND TESTING OF HIGHWAY MATERIALS TO MITIGATE ICE ADHESION Interim Report, Oct. 1976 - Apr. 1977**
M. Krukar and J. C. Cook Mar. 1978 157 p refs
(Contract EPA-R-804660)
(PB-280927/5; EPA-600/2-78-035) Avail: NTIS HC A08/MF A01 CSCL 13B

Field tests at the WSU Pavement Test Facility augment BBRC laboratory tests with comparative results. Factors of concern included pavement type, tire type, environment and toxicity, wear, ice/snow adhesion and asphalt overlays which included the substances as a component of the mix. Although the winter conditions were mild, the limited amount of tests and data did allow a ranking based on skid resistance change, water beading, and snow/ice removal properties of the different formulations. The most effective formulations were combinations of modified traffic paints and room-temperature-curing silicone rubber. Of the formulations tested only one was deemed toxic. GRA

**N78-31277#** National Severe Storms Lab., Norman, Okla.
**THE TORNADO: AN ENGINEERING-ORIENTED PERSPECTIVE**
Joseph E. Minor (Tex. Tech. Univ., Lubbock), James R. McDonald (Tex. Tech. Univ., Lubbock), and Kishor C. Mehta (Tex. Tech. Univ., Lubbock) Dec. 1977 216 p refs
(Grant NOAA-04-4-022-38)
(PB-281860/7; NOAA-TM-ERL-NSSL-82; NOAA-78042008) Avail: NTIS HC A10/MF A01 CSCL 13M

Fundamental concepts of tornado-building interaction phenomena are discussed to assist the meteorologist in understanding and interpreting wind damage, and to assist the engineer in assessing wind resistance of building construction. Studies of tornadic windspeeds and atmospheric pressure change indicate that: (1) buildings fail at relatively low windspeeds; (2) no conclusive evidence can be found that ground level windspeeds exceed 250 mph (112 m/s); (3) most building damage is caused by winds in the 75-125 mph (34-56 m/s) range; and (4) atmospheric pressure changes in tornadoes play only a minor role in the damaging mechanism. GRA

**N78-31278#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
**SIMULATION OF THE URBAN NEUTRAL BOUNDARY LAYER FOR THE MODEL STUDY OF WIND LOADS ON TALL BUILDINGS Research Report, 1 Dec. 1975 - 1 Jun. 1977**
T. A. Reinhold, H. W. Tieleman, and F. J. Maher Mar. 1978 74 p refs
(Grant NSF ENG-75-05327-A01)
(PB-280787/3; NPI-E-77-12) Avail: NTIS HC A04/MF A01 CSCL 13M

A turbulent shear layer similar to that found in the atmospheric boundary layer under strong wind conditions (neutral atmospheric conditions) was generated in a wind tunnel with a short test section by using a combination of spires and floor roughness elements. Flow properties were measured in detail at the model location 7 meters downstream of the spires. Properties measured included the mean velocity and turbulence characteristics for all three velocity components. Turbulence properties included intensities, some covariances, integral length scales and power spectra. The flow was found to be two dimensional across the central 600 mm of the tunnel and to be reasonably homogenous in the direction of flow. GRA

**N78-31279#** Advisory Group for Aerospace Research and Development, Paris (France).
**IMPACT OF CHARGE COUPLED DEVICES AND SURFACE ACOUSTIC WAVE DEVICES ON SIGNAL PROCESSING AND IMAGERY IN ADVANCED SYSTEMS**
Y. Brault, ed. Jun. 1978 479 p refs Partly in ENGLISH and FRENCH Presented at Avionic Panel Symp., Ottawa, 11-15 Oct. 1977
(AGARD-CP-230; ISBN-92-835-0216-7) Avail: NTIS HC A21/MF A01

The mission of AGARD is to bring together the leading personalities of the NATO nations in the fields of science and technology relating to aerospace. The mission of AGARD is carried out through the Panels which are composed of experts appointed by the National Delegates, the Consultant and Exchange Program and the Aerospace Applications Studies Program. The results of AGARD work are reported to the member nations and the NATO Authorities through the AGARD series of publications of which this is one. The reported symposium was divided into five sessions: (1) fundamental technology and trends; (2) technology and devices; (3) fundamental modules/subsystems; (4) imagery; and (5) signal processing. For individual titles, see N78-31280 through N78-31319.

**N78-31280#** Texas Instruments, Inc., Dallas.
**STATE-OF-THE-ART OF CCD AND SAW TECHNOLOGIES** **c33**
Lewis T. Claiborne *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 11 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

A survey of the status of component technologies for charged coupled devices (CCD) and surface acoustic wave devices (SAW) is presented in terms of device performance and application to subsystem signal processing functions. The performance is discussed for imaging and image processing as well as analog and digital signal processing. Recent developments are mentioned including resonator filters and transform processing. G.Y.

**N78-31281#** Royal Signals and Radar Establishment, Malvern (England).
**THE ROLES FOR CCD AND SAW IN SIGNAL PROCESSING** **c32**
J. B. G. Roberts *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 16 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

The recent emergence of two radically new methods for the real time processing of signals raised the important question of how they best be used and how they relate to one another and to other techniques. The key factors determining the effectiveness of CCD and SAW in a range of application fields are discussed. The roles in which they are likely to be most appropriate and how they compare with the rapidly expanding range of digital devices are assessed. As well as contrasting the techniques in mutually exclusive situations, it is shown how it is often possible to complement one with another to good effect. G.Y.

**N78-31282#** Rome Air Development Center, Griffiss AFB, N.Y. Deputy for Electronic Technology.
**MATERIAL CHOICE FOR OPTIMUM SAW DEVICE PERFORMANCE** **c32**
Robert M. OConnell, Andrew J. Slorodnik, Jr., and Paul H. Carr *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 19 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

The theory of surface acoustic wave propagation is reviewed and some of the various material design parameters which follow from that theory must be considered in making the optimum SAW device substrate choice. The parameters covered include SAW velocity, piezoelectric coupling constant, electro-mechanical power flow angle, temperature sensitivity, propagation losses, and beam steering and diffraction. Depending upon the device being designed and the application, some of those parameters are more important than others. In the design of temperature stable, broadband, low insertion loss devices, the important

requirements are a zero temperature coefficient of time delay and a large piezoelectric coupling constant. Alternatively, the design of high frequency devices requires low loss substrate materials with large SAW velocities. The state of the art in the development of new materials for these two classes of devices is reviewed. Author

**N78-31283#** Laboratoire Central de Recherches Thomson-CSF, Orsay (France).

**MICROWAVE SURFACE-ACOUSTIC-WAVE COMPONENTS c33**

P. Hartemann *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 9 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

Various surface acoustic wave components operating at frequencies greater than 1 GHz were realized using an electron beam pattern generator. Fabrication process is described and the main features of devices are reported. Simple and tapped delay lines operating at about 1.3 GHz with a 3 db bandwidth close to 500 MHz were performed with lithium niobate substrates. The maximum delay time is equal to 10 micro seconds. Large bandwidth coded lines and dispersive delay lines were also tested. Narrow bandwidth filters were realized using sampled inter digital transducers deposited on surfaces of lithium niobate and quartz substrates. A relative bandwidth of 0.0008 was obtained. Oscillators were implemented with such filters up to 2 GHz, the substrates being ST cut quartz plates. G.Y.

**N78-31284#** Microwave and Electronic Systems Ltd., Newbridge (Scotland).

**DEVELOPMENT OF A 100MHz BANDWIDTH PULSE COMPRESSION SUBSYSTEM FOR AIRBORNE APPLICATION c33**

M. B. N. Butler *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 10 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

A substrate design incorporating SAW devices for passive signal encoding and pulse compression with 100 MHz bandwidth and 5 microsecond dispersion is described. The paper is divided into three parts covering SAW devices design, subsystem design and environmental testing. In order to minimize weight and power consumption the SAW devices were designed for implementation on ST-X quartz substrates. With this material and appropriate mechanical layout only minor changes in device performance are visible over an operating temperature range in excess of 100 C. In this development a new approach to the design of double dispersive, angle chirp filter is taken. The technique resulted in SAW devices with T.B. = 500, insertion loss less than 45 db and matched to give a compressed pulse width of 15 nanoseconds with 34 db sidelobe suppression. Subsystem design, including high gain, broadband amplifiers shows the need for care in mechanical and electrical layout and screening. Attention is given to design for low R.F.I. and good pulse compression performance in a unit operating in an airborne environment. Author

**N78-31285#** Sperry Research Center, Sudbury, Mass.

**SIGNAL PROCESSING WITH A REFLECTIVE DOT ARRAY (RDA) c32**

L. P. Solie and H. VanDeVaart *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 4 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

A new type of pulse compression filter is described using the Reflective Dot Array (RDA). The RDA is similar to the Reflective Array Compressor (RAC), except that the array of reflecting grooves is replaced by an array of reflecting metallic dots. The RDA has the principle advantage of being part of the same mask and metallization as the interdigital transducers, allowing single-stop fabrication. A linear FM filter was developed with a center frequency of 60 MHz, bandwidth of 20 MHz and differential time delay of 10 microsecond, with less than 3 degrees of rms phase deviation from quadratic without phase compensating film, showing that high performance pulse compression filters can be produced at low cost. G.Y.

**N78-31286#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

**INFLUENCE OF ACCELERATION ON SURFACE ACOUSTIC WAVE OSCILLATORS c33**

Michel Valdois, Patrick Levesque, and Pierre Hartemann (Laboratoire Central de Rech. Thomson-CSF, Orsay, France) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 6 p refs In FRENCH; ENGLISH summary (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

The influence of acceleration on oscillators using a delay line or a resonator with surface acoustic waves was studied in the 0 - 30 g range. The surface wave oscillators were installed on a variable speed rotating arm. The piezoelectric substrates used were in quartz of ST and Y cut. Several directions of acceleration were experimented. The frequency shift due to acceleration is as a first approximation, a linear function of the acceleration magnitude. With a surface wave resonator made of two transducers placed in a cavity defined by two periodic reflecting networks, the maximum sensitivity is 48 Hz/g at 124 MHz for an acceleration direction to the propagation surface. Results show that the acoustic surface wave oscillators, in their present form, are more sensitive to acceleration than the volume wave oscillators. The ratio of relative sensitivity increase is of the order of 100. G.Y.

**N78-31287#** Laboratoire Central de Recherches Thomson-CSF, Orsay (France).

**TUNABLE MAGNETOELASTIC SURFACE WAVE OSCILLATORS c33**

G. Volluet *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 11 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

A new technique for achieving the frequency control of SAW oscillators with an external magnetic field was experimented. Magnetoelastic Raleigh wave delay lines using ZnO transducers were fabricated with Gd-Ga Y.I.G. epitaxial films grown on G.G.G. substrates. An important phase velocity shift was obtained as a function of an external biasing magnetic field through a magnetoelastic interaction. Feedback oscillators were implemented using this kind of delay lines. A frequency change up to 1650 ppm around 211.5 MHz and 1800 ppm around 339.5 MHz were obtained by sweeping a biasing magnetic field over a 70 Oe range. G.Y.

**N78-31288#** Allen Clark Research Centre, Towcester (England).

**PERFORMANCE LIMITATIONS OF TWO PHASE CCD'S c33**

V. A. Browne *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 8 p refs (For primary document see N78-31279 22 31)
Avail: NTIS HC A21/MF A01

There are several different techniques available for achieving two-phase operation. These are discussed and compared. The performance of two-phase CCD's (charged coupled devices) fabricated with a coplanar, N-channel, double-level polysilicon gate process is described and compared between devices fabricated with stepped-oxide, implanted barriers and offset-gate structures. A comparison between surface and buried channel devices is also made. A basic three-phase charge transfer system was studied, and whilst such structures are simple in concept, they are difficult to operate. Performance limitations of a number of two-phase CCD structures when operating in both two-phase and the uniphase mode are discussed. Their performance is compared to the equivalent three-phase device. G.Y.

**N78-31289#** Edinburgh Univ. (Scotland). Dept. of Electrical Engineering.

**THE DESIGN AND DEVELOPMENT OF CCD PROGRAMMABLE TRANSVERSAL FILTERS AND CORRELATORS c33**

J. Mavor and P. B. Denyer *In* AGARD Impact of Charge

Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 16 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

The potential of integrated circuit-based convolers for baseband operation is examined. The emphasis is on compact processor development with an eventual aim of a single chip, monolithic design suitable for a variety of signal processing applications. Trade-offs of serial and parallel configurations of convolers are considered together with their respective component requirements. Following a description of a Deltic serial processor (having a time-bandwidth product of 500) a study is made of the circuit elements of a particular realization of an integrated convoler in CCD/MOS technology. All aspects of the design are considered and the description is focussed around a prototype 64-stage convoler. The future of this approach is discussed and thought to be capable of 255 convolution points on a single chip. G.Y.

**N78-31290#** Rockwell International Corp., Anaheim, Calif.
**A HYBRID SAW/CCD SIGNAL PROCESSOR c32**
William H. Conway and Dirk R. Kloss (Army Electronic Warfare Lab., Fort Monmouth, N. J.) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 8 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

The combining of SAW and CCD technologies to produce a hybrid signal processor capable of performing bandwidth compression on signals of short time duration while maintaining their phase relationships is discussed. The devices used in fabricating a feasibility brassboard are described and test results influencing the design of such hybrid processors are presented. G.Y.

**N78-31291*#** Bell-Northern Research Ltd., Ottawa (Ontario).
**A WIDE BANDWIDTH CCD BUFFER MEMORY SYSTEM c60**
K. Siemens, R. W. Wallace, and C. R. Robinson *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 9 p refs (For primary document see N78-31279 22-31)
(Contract NAS1-13507)
Avail: NTIS HC A21/MF A01 CSCL 09B

A prototype system was implemented to demonstrate that CCD's can be applied advantageously to the problem of low power digital storage and particularly to the problem of interfacing widely varying data rates. CCD shift register memories (8K bit) were used to construct a feasibility model 128 K-bit buffer memory system. Serial data that can have rates between 150 kHz and 4.0 MHz can be stored in 4K-bit, randomly-accessible memory blocks. Peak power dissipation during a data transfer is less than 7 W, while idle power is approximately 5.4 W. The system features automatic data input synchronization with the recirculating CCD memory block start address. System expansion to accomodate parallel inputs or a greater number of memory blocks can be performed in a modular fashion. Since the control logic does not increase proportionally to increase in memory capacity, the power requirements per bit of storage can be reduced significantly in a larger system. G.Y.

**N78-31292#** Bell-Northern Research Ltd., Ottawa (Ontario).
**A MICROPROCESSOR CONTROLLED ELECTRICALLY PROGRAMMABLE TRANSVERSAL FILTER c60**
A. Chowaniec, R. W. Wallace, M. A. Copeland (Carleton Univ., Ottawa), and Y. A. Haque (Carleton Univ., Ottawa) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 9 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

A real time electrically programmable transversal filter which promises to have considerable potential for sampled analog data signal processing is described. Results obtained using the filter in combination with a microprocessor are presented. The filter is based on a novel functional multiplying structure in the standard silicon gate MOS process. The analog multiplication of signals is achieved by digitally selecting the application of controlled analog signal voltage on the semiconductor inversion layer side of an MOS capacitor - a process that is linear and free of signal interaction (crosstalk) between taps. A microprocessor is used to manipulate and load the tap data. A programmable filter of this type can find wide application in advanced signal processing systems and some discussion is presented on its applicability to areas as adaptive filtering for communications and matched filtering for spread spectrum modes. Author

**N78-31293#** AEG-Telefunken, Ulm (West Germany).
**DESIGN AND PERFORMANCE OF SAW-RESONATORS AND RESONATOR-FILTERS c33**
W. H. Haydl (Fraunhofer Gesellschaft, Freiburg), P. Hiesinger (Fraunhofer Gesellschaft, Freiburg), G. Kohlbacher, and P. Schmitt *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 7 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

One-, two- and three-port SAW resonators on ST-quartz and YZ-lithium niobate were developed employing aluminum metallization. Investigations were carried out on the important parameters for the design of SAW resonators, such as the reflection coefficient, number of reflector elements, reflector and transducer placement, and terminating impedance. Out of the many possible different designs the most promising ones are described in detail: control of the center frequency, permanant trimming to the final frequency by sputtering of thin films and in situ measurement, electronic tuning by means of varactors, low loss, series operation of several devices giving up to 100 db sidelobe signal suppression, multimode operation, and oscillators with single- and multiple-mode resonators, respectively. G.Y.

**N78-31294#** Rome Air Development Center, Hanscom AFB, Mass.
**SYSTEMS APPLICATIONS OF SAW FILTERS AND DELAY LINES c33**
Paul H. Carr *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 12 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

The applications that SAW (surface acoustic waves) filters and delay lines have to communications and radar systems are reviewed. The development of SAW resonators at frequencies up to 1 GHz is reported together with their promise for stabilizing precision oscillators. Operation directly at 1 GHz eliminates the multiplier chains required for conventional quartz oscillators. The use of miniature SAW transversal filters for banks of contiguous filters is shown to be important in reducing the size of fast frequency synthesizers and multiplexers for spread-spectrum communications applications. The design of a 9.1 microsecond delay line with all spurious echoes 70 db down is described together with its radar signal processing application. G.Y.

**N78-31295#** Motorola, Inc., Scottsdale, Ariz.
**THE MONOLITHIC INTEGRATION OF SURFACE ACOUSTIC WAVE AND SEMICONDUCTOR CIRCUIT ELEMENTS ON SILICON FOR MATCHED FILTER DEVICE DEVELOPMENT c33**
Fred S. Hickernell and Henry J. Bush *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 13 p refs Prepared in cooperation with RADC, Griffiss AFB, N. Y. (For primary document see N78-31279 22-31)
(Contracts F30602-74-C-0021; F30602-76-C-0134)
Avail: NTIS HC A21/MF A01

Work on the development of silicon-based monolithic programmable matched filter SAW devices capable of generating and processing binary code data is presented. Two programmable filters were designed, fabricated and tested using zinc oxide film transducers for surface acoustic wave generation, piezoresistive MOSFET taps for detection, and semiconductor logic elements for phase and amplitude control of the taps. The filters were developed at a carrier frequency of 100 MHz, with a 10 MHz bandwidth and a capability for generating and correlating 31-bit PN sequences. The developments serve to demonstrate the

visibility of the monolithic integration of SAW and semiconductor elements, and permitted assessment of various aspects of the technology. G.Y.

**N78-31296#** Norges Tekniske Hoegskole, Trondheim. Dept. of Electrical Engineering.
**EXPERIMENTS AND ANALYSIS OF ACOUSTOELECTRIC MEMORY CORRELATORS c33**
K. A. Ingebrigtsen, A. Ronnekleiv, and S. Stueflotten *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 14 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

Progress in the development of acoustoelectric diode memory correlators is described. The fabrication technique is described in some detail and experimental results from devices using Schottky diodes and pn-diodes are given. This model describes several of the experimentally observed features in the recording process, of the storage, and of the correlation readout. The experiments suggest that the model needs improvements in the description of the recording process. G.Y.

**N78-31297#** Compagnie Generale de Telegraphie sans Fil, Paris (France). Div. des Activites Sous-Marines Chemin des Travails.
**CONVOLUTION AND CORRELATION MEMORY BY MEANS OF SURFACE ACOUSTIC WAVE DEVICES [CONVOLUTION ET CORRELATION A MEMOIRE A L'AIDE DE COMPOSANTS ACOUSTIQUES A ONDES DE SURFACE] c33**
H. Gautier, C. Maerfeld, and P. Tournois *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 14 p refs In FRENCH (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

A device with two inputs and one output capable of generating the convolution product of the two input signals is described, and a simple solution that utilizes counterdirective surface acoustic waves in support of information processing is studied.
Transl. by B.B.

**N78-31298#** TRW Defense and Space Systems Group, Redondo Beach, Calif.
**LSI VIDEO COMPRESSION AND COMPUTATIONAL MODULES UTILIZING DIGITAL CHARGE COUPLED DEVICES c32**
R. A. Allen, D. J. Spencer, and C. S. Miller *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 10 p refs (For primary document see N78-31279 22-31) (Contract N00014-74-C-0068)
Avail: NTIS HC A21/MF A01

The techniques used in the design of LSI arithmetic arrays are described and is referred to as Digital Charge Coupled Logic (DCCL). An LSI Video Compression Module concept utilizing the DCCL technology is described, that compresses video data by interface transform coding. The design of the DCCL arithmetic and control chips are also described. In particular is the use of these two types of DCCL LSI chips in the realization of the Itakura analysis - synthesis algorithm for a linear predictive coding (LPC) using partial correlation (PARCOR) techniques. G.Y.

**N78-31299#** Allen Clark Research Centre, Towcester (England).
**CHARGE COUPLED DEVICES WITH SIMPLIFIED DRIVE REQUIREMENTS c33**
J. N. Gooding *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 7 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

The capabilities of charge coupled devices make them attractive for a wide range of signal processing applications. However, their advantages are diminished if they need to be surrounded by a significant amount of support circuitry. To what extent this peripheral circuitry can be simplified if not eliminated is discussed. Two delay line designs are discussed in detail. In an audio delay line all the support circuitry can be integrated onto the CCD chip. Power considerations prevent this being done at video frequencies. However, it is possible to reduce the video delay line drive requirements to a single phase clock drive - all other required waveforms, etc. being generated on chip. G.Y.

**N78-31300#** Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).
**SAW FILTER APPLICATION FOR PHASED ARRAY RADAR c32**
W. Sander and W. H. Haydl (Inst. fuer Angew. Festkorperphysik der Fraunhofer-Ges.) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 11 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

Some peculiarities of the array system which influences the design of the filtering devices in the 1F-amplifier are given. The design, development, and fabrication of two types of SAW filters for the 1F-amplifier of the receiving array for a phased array radar (Electronically Steerable Radar) are discussed. Compared to conventional filters with lumped elements, these filters have some important merits. Their use represents one of the few applications where high quality mass-produced SAW devices were applied to improve the system performance. G.Y.

**N78-31301#** Societe Anonyme de Telecommunications, Paris (France).
**MODELIZATION OF METAL INSULATING SEMICONDUCTOR DEVICES ON CgHgTe APPLICATION TO A CHARGE TRANSFER DEVICE FOR INFRARED IMAGERY [MODELISATION DE STRUCTURES METAL-ISOLANT-SEMICONDUCTEUR SUR Cd Hg Te APPLICATION AUX DISPOSITIFS A TRANSFERT DE CHARGE POUR IMAGERIE INFRAROUGE] c33**
M. Sirieix, M. Garcia (Comm. a l'Energie Atomique, Grenoble), J. Farre (Lab. d'Automatique et d'Anal. des Systemes), and J. Simonne (Lab. d'Automatique et d'Anal. des Systemes) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 17 p refs In FRENCH (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

Elementary structural models of a matrice adapted to scanning by charge transfer are studied. This MIS element detects the infrared radiation and integrates created charges. These two functions lead to limitations that modify the conception of infrared systems. Performance predictions for the models were also made. The addressing and scanning modes of a bidimensional matrice are discussed. A comparison was made between charge injection devices and charge coupled devices, and possible choices for obtaining a true matrice was discussed. Transl. by B.B.

**N78-31302#** Rensselaer Polytechnic Inst., Troy, N. Y.
**IRCCD IMAGING SENSORS: A REVIEW OF DEVICE OPTIONS c74**
Andrew J. Steckl *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 15 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

A review is presented of the many device options investigated for the development of integrated infrared focal plane arrays. With only one or two exceptions, the approaches developed are centered on the charge coupled device (CCD) concept or its close relative, the charge injection device (CID). Monolithic and hybrid IRCCD and IRCID device options are classified, discussed and compared. B.B.

**N78-31303#** Reticon Corp., Sunnyvale, Calif.
**CCPD: THE OPTIMUM SOLID-STATE LINE SCANNER c33**
Hsin-Fu Tseng and Gene P. Weckler *In* AGARD. Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 12 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

Optimized solid state line scanners were developed and described. They offer many advantages for applications requiring high sensitivity, low noise, and spectral purity. Photodiodes are

employed as the detector elements, thus assuring maximum quantum efficiency and a broad, smooth spectral response, both characteristic of a good silicon photodiode. A charge-transfer device is used to provide the low noise readout. The combination of photodiodes and analog shift register results in the optimum solid state line scanner. In addition, these devices contain antiblooming circuitry as well as output buffer amplifiers. B.B.

**N78-31304#** Compagnie Generale de Telegraphie sans Fil, Paris (France). Div. des Activities Sous-Marines Chemin des Travails.

**READING AND ACOUSTIC PROCESSING OF OPTICAL IMAGES [LECTURE ET TRAITEMENT ACOUSTIQUES D'IMAGES OPTIQUES]** **c71**

H. Gautier, C. Maerfeld, and P. Tournois *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 11 p refs In FRENCH (For primary document see N78-31279 22-31)

Avail: NTIS HC A21/MF A01

The geometry of devices utilized in optical image readings as well as operation principles are summarized. It was shown how these devices effect the direct reading of an image. The benefits of the phenomena of photon integration under conditions of sensor arrangement in a network of integrated diodes was reviewed. The systems that utilize these networks were studied in detail due to the fact that they demonstrate the highest sensitivity. Various other proposals for image reading were also included. Transl. by B.B.

**N78-31305#** Army Electronics Command, Fort Monmouth, N. J.

**APPLICATIONS OF A CHARGE COUPLED DEVICE SENSOR FOR NAP-OF-THE-EARTH HELICOPTER OPERATIONS** **c33**

A. Kleider *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 16 p refs (For primary document see N78-31279 22-31)

Avail: NTIS HC A21/MF A01

The geometric characteristic of a wire obstacle was conceptually integrated with the discrete elemental structure of a charge couple device (CCD). This quantized detector structure provides a means for formulating a wire obstacle warning system (WOWS) utilizing advances in technology to arrive at a low cost system for use by helicopters flying Nap-of-the-Earth (NOE). The WOWS employs a CCD detector array and other monolithic semiconductor devices to achieve small size, lightweight, and low cost. The video information is logically processed to provide a symbolic display of the range and location of the wire obstacle relative to the aircraft heading as well as an audio visual alarm for the pilot. The concept of single site activation (SSA) provides a means of achieving wire pattern recognition which removes the requirement of having a human observer in the detection recognition loops. B.B.

**N78-31306#** Plessey Radar Ltd., Havant (England).

**A CCD DIGITAL IMAGE STORE** **c35**

D. M. Balston and P. R. Samways *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 9 p refs (For primary document see N78-31279 22-31)

Avail: NTIS HC A21/MF A01

A digital image store, based on CCD technology designed for an image processing system is described. The processing system, termed IDP 3000, was introduced to fulfill a requirement in the field of Earth Resource Surveying and the design of the store reflects the requirements of the specific area application. The requirements were introduced and the specific solution adopted is described. Particular attention is paid to the relationship with a standard 625 line TV signal. Each function available in the store is discussed and the method of implementation is summarized. An indication of the reliability of the store was given as well as a description of its application to simulator development. B.B.

**N78-31307#** AEG-Telefunken, Ulm (West Germany).

**A CCD MEMORY CHIP FOR RADAR IMAGE PROCESSING** **c32**

K. Rodde, E. Stein, and H.-J. Wulf *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 10 p refs Sponsored by the Federal Ministry of Research and Technology, the Federal Republic of Germany (For primary document see N78-31279 22-31)

Avail: NTIS HC A21/MF A01

Considerations for the design of a digital CCD memory are discussed. Starting from commercial CCD devices, the design characteristics of a second generation CCD were derived. The economically feasible capacity and its dependency on the technology lead to the definition of performance parameters and the chip organization. A SPS organization was found most suitable and design considerations of SPS blocks are summarized. The overal design of a 32 kbit CCD is described. B.B.

**N78-31308#** Carleton Univ., Ottawa (Ontario).

**ELECTRO-OPTICAL PROCESSING OF SIGNALS AND IMAGES** **c32**

D. Roy, M. A. Copeland, and C. H. Chan *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 9 p refs (For primary document see N78-31279 22-31)

Avail: NTIS HC A21/MF A01

The use of an LED/CCD structure to perform transversal filtering of electrical signals was demonstrated. The action of convolution is achieved by progressive summation as against the simultaneous summation of tap weighted signal samples as in the split electrode CCD filter. Summation is done in a given CCD potential well as it is first created and then progressively clocked to the output end of the device. The multiplications necessary in a convolution operation are obtained by means of an optical mask which controls the amount of light from a signal modulated LED reaching the various CCD electrodes. The two types of processing are described and experimental results are given. Discussions on performance limitations were also included. B.B.

**N78-31309#** General Electric Co., Schenectady, N. Y.

**CHARGE INJECTION DEVICE (CID) HADAMARD PLANE PROCESSOR FOR IMAGE BANDWIDTH COMPRESSION** **c74**

G. J. Michon, H. K. Burke, T. L. Vogeloong, and P. A. Merola *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 5 p Sponsored by AFAL, Wright-Patterson Air Force Base, Ohio (For primary document see N78-31279 22-31)

Avail: NTIS HC A21/MF A01

A charge injection device (CID) solid state video sensor capable of producing a Hadamard transform of the incident optical image was developed. The device can be operated so as to produce a normal video signal. In a second mode, the device produces four 1x4 Hadamard transforms in parallel. Minimal off-chip hardware is required to produce a 4x4 two-dimensional transform. This approach offers an opportunity to reduce the size and power requirements of on-board electronics in mini-RPV and guided weapon antijam video data link applications by performing the Transform processing function of the airborne encoderer directly on the image plane. Performance of the device was verified by completing the two dimensional transform of various images, performing the inverse transform, and displaying the resultant images. B.B.

**N78-31310#** Bell-Northern Research Ltd., Ottawa (Ontario).

**A HIGH PERFORMANCE CCD LINEAR IMAGING ARRAY** **c33**

A. A. Ibrahim, J. J. White, K. G. McQuhae, K. Y. Yu, D. Gallant, W. C. Bradley (Itek Corp., Lexington, Mass.), and D. W. Colvin (Itek Corp., Lexington, Mass.) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 10 p (For primary document see N78-31279 22-31)

Avail: NTIS HC A21/MF A01

The development of high performance CCD linear images was highlighted. The imager was fabricated with two level polysilicon buried channel CCD process. Photocharge collected

in the odd and even sensors are read out via two serial shift registers which are clocked synchronously. The novel design technique involved in synchronized clocking systems is described. Test results are described and include noise spectral density, MIF curves and transfer efficiency measurements. The measurement of noise performance shows considerable improvement in comparison to similar available images. Pictures taken using the imagers are shown. B.B.

**N78-31311#** Microwave and Electronic Systems Ltd., Newbridge (Scotland).
**DEVELOPMENT AND APPLICATION OF A SAW CHIRP-Z TRANSFORMER c33**
M. B. N. Butler *In* AGARD Impact of Charge Coupled devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 10 p refs Sponsored in part by the Ministry of Defense (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

A development is reported in which the Chirp-z transform algorithm is truncated to perform spectral amplitude analysis. The basic process is described in relation to a unit giving in excess of one hundred resolved spectral lines with a resolution of 50kHz and a total processing time of 50 microseconds per data set. The displayed spectrum covers a dynamic range in excess of 36db (six bits) essentially linearly and without process induced spurious signals. The distinct applications of the unit are considered to a coherent microwave radar in which Doppler spectral analysis is employed and to signal analysis in a 10 micron wavelength laser wind velocity equipment. In both applications the high speed of the unit has proved to be particularly significant. B.B.

**N78-31312#** Raytheon Co., Bedford, Mass. Missile Systems Div.
**THE CHIRP Z TRANSFORM WITH CCD AND SAW TECHNOLOGY c33**
D. MacFall, J. Collins, Sclarretta, and A. Cappon *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 13 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

The Chirp Z transform (CZT) is presented as an IF process that makes use of time compression and chirp pulse compression. This allows sampled signals to be stored in CCD memory for milliseconds or more, and Z transformed by the chirp filter in microseconds. A CZT spectrum analyzer therefore has extremely high throughput and the capability to process many channels with one processing element. Some applications require both magnitude and phase information. Configurations that achieve a linear complex output by removal of residual quadratic phase is shown, resulting in sidelobe levels that are independent of transform size. B.B.

**N78-31313*#** Texas Instruments, Inc., Dallas.
**SPECTRAL ANALYSIS USING THE CCD CHIRP Z-TRANSFORM c33**
W. L. Eversole, D. J. Mayer, P. W. Bosshart, M. Dewit, C. R. Howes, and D. D. Buss *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 19 p refs (For primary document see N78-31279 22-31)
(Contract NAS1-14290; DAAB07-76-C-1386)
Avail: NTIS HC A21/MF A01

The charge coupled device (CCD) Chirp Z transformation (CZT) spectral analysis techniques were reviewed and results on state-of-the-art CCD CZT technology are presented. The CZT algorithm was examined and the advantages of CCD implementation are discussed. The sliding CZT which is useful in many spectral analysis applications is described, and the performance limitations of the CZT are studied. B.B.

**N78-31314#** Thomson-CSF, Malakoff (France).
**APPLICATIONS OF PIEZOELECTRIC CONVOLUTERS TO RADAR SIGNAL PROCESSING [APPLICATIONS D'UN CONVOLUTEUR PIEZOELECTRIQUE AU TRAITEMENT DU SIGNAL RADAR] c32**
P. Anthoward and T. Beauvais *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 17 p refs In FRENCH (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

Piezoelectric convoluters are described along with relative interfaces. Examples of convoluter relationships with radar processing lines such as time of arrival measurement and signal identification, and processing of an outlet for a lateral synthetic radar antenna are given. Emphasis was placed on a comparison made between acoustic and numerical processing.
Transl. by B.B.

**N78-31315#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**OPERATION OF SAW REFLECTIVE ARRAY PULSE COMPRESSORS IN A HIGH PERFORMANCE RADAR WITH MINUS 0.4 METER RANGE RESOLUTION c32**
W. J. Ince, S. C. Cottrill (RCA, Marshall Islands), and P. Gelzinis (RCA, Marshall Islands) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 16 p refs Sponsored in part by the US Army (For primary document see N78-31279 22-31)
(Contract F19628-76-C-002)
Avail: NTIS HC A21/MF A01

The application of L-band reflective array pulse compression devices with a time-bandwidth product of 5120 to a high resolution radar is described. This is believed to be the largest time bandwidth product for any reflective array compressor (RAC) in an operational system. The subject radar is the ALCOE, which is a C-band instrumentation tracking radar designed to provide precision trajectory and signature information on space vehicles. In its waveform inventory ALCOR has a wideband operating mode with a 512-MHz instantaneous bandwidth (0.4 meter range resolution) that permits resolution of the individual scattering centers of a target. Author

**N78-31316#** Southampton Univ. (England).
**A NOVEL SIGNAL INTEGRATOR USING CCDs c32**
C. P. Trayner, P. C. T. Roberts, R. G. Taylor (Admiralty Surface Weapons Establishment, Portsmouth, Engl.), J. D. E. Beynon, and G. G. Bloodworth *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 12 p refs Sponsored by Ministry of Defense (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

The implementation of two types of CCD signal integrator using nonrecursive and recursive integration is described. In order to miminize the effects of transfer inefficiency, a parallel transfer scheme is employed in which information is sequentially gated into storage areas with an on chip tapped CCD register. Test devices are described that were used to investigate the proposed implementations and, in particular, the on chip addressing scheme. The results presented demonstrate the feasibility of the techniques and also show good agreement with the predicted performance. The data obtained from the test devices enabled a modified integrator to be designed, incorporating several improvements which are also described. B.B.

**N78-31317#** Thomson-CSF, Bagneux (France).
**CCD DELAY LINES FOR THE PROCESSING OF A RADAR SIGNAL: APPLICATION TO AN MTI [LIGNE A RETARD DUTYPE CCD POUR TRAITEMENT DU SIGNAL RADAR APPLICATION A UN MTI] c32**
J. L. Berger, D. Reneric (STTA, Paris), and R. Vanhove *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 23 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

A delay line composed of two registers of 512 stages is described as well as the performance reliability of linear and dynamic transfer. A preliminary study of the filter properties for a moving target indicator is presented. Performance levels achieved with delay lines with 256 stages, circuits associated with delay lines necessary to compensate for the limits of charge coupled

devices and temperature problems are also summarized.
Transl. by B.B.

**N78-31318#** Standard Telecommunication Labs. Ltd., Harlow (England).
**A CCD DELAY LINE DOPPLER ANALYSER c32**
J. D. Jackson, G. R. Adams, and J. S. Heeks *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 8 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

A CCD spectrum analyzing filter which is compatible with the real time processing of Doppler radar signals is reported. The scheme is based on the coherent memory filter (CMF) principle and has the feature of a simple delay line. Experimental results are presented for a prototype system providing a 50-point transform and performance limits as determined by the fundamental parameters of the CCD. In an extension of the approach it is proposed to interface the analyzer with an analogue tapped delay line in order to effect both range and Doppler processing.
B.B.

**N78-31319#** Kaiserslautern Univ. (West Germany).
**COMBINED ACQUISITION AND FINE SYNCHRONIZATION SYSTEM FOR SPREAD SPECTRUM RECEIVERS USING A TAPPED DELAY LINE CORRELATOR c32**
W. P. Baier, M. Pandit, and H. Grammuller (Siemens AG, Munich) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 12 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

In direct sequencing spread spectrum communications systems a local PN generator must be synchronized with the PN code contained in the incoming signal at the receiver. A method of using a tapped delay line correlator not only for acquisition but also for tracking is presented. At the outset PN clock generators of high inherent stability and low relative drift at the transmitter and receiver are employed. The correlation peaks at the output of the tapped delay line correlator are used to set the receiver PN generator in phase with the received PN code. During the intervals of time between the correlation peaks the local PN generator runs freely. A system including the hardware realization based on this principle is presented. The salient theoretical results were checked by measurements. B.B.

# 32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

**N78-31320** Maryland Univ., College Park.
**NOISE MEASUREMENTS OF AN ALUMINUM GRAVITATIONAL RADIATION ANTENNA AT 5 TO 9 KELVIN Ph.D. Thesis**
William Scott Davis 1977 111 p
Avail: Univ. Microfilms Order No. 78-11936

A 135 kg aluminum antenna for gravitational radiation was cooled to liquid helium temperatures. It was instrumented with a d.c. biased resonant capacitor sensor. Noise measurements were made from 5 to 9 Kelvin. The best measurements of the total noise temperature of the antenna were within 10 to 30 per cent of that expected from theory. Of this 2.2 Kelvin is attributed to the preamplifier. The fluctuation noise temperature of the antenna was measured to be .43 plus or minus .07 Kelvin. Furthermore, the probability density and autocorrelation of the noise were also measured and found to be within 10 to 20 per cent of expectations. Dissert. Abstr.

**N78-31321*** National Aeronautics and Space Administration. Pasadena Office, Calif.
**REFLEX FEED SYSTEM FOR DUAL FREQUENCY ANTENNA WITH FREQUENCY CUTOFF MEANS Patent**
Robert W. Hartop, inventor (to NASA) (JPL) Issued 30 May 1978 4 p Filed 24 Mar. 1977 Supersedes N77-24338 (15 - 15, p 1976) Sponsored by NASA
(NASA-Case-NPO-14022-1; US-Patent-4,092,648; US-Patent-Appl-SN-780728; US-Patent-Class-343-782; US-Patent-Class-343-837; US-Patent-Class-343-781CA) Avail: US Patent Office CSCL 09C

A reflex feed system is described for a dual frequency antenna such as one which transmits and receives both S and X band signals. The dichroic plate, normally employed for directing X band radiation away from the X band horn, is replaced by a flange about the opening of the X band horn.
Official Gazette of the U.S. Patent Office

**N78-31322** State Univ. of New York at Albany.
**RESONANT SCATTERING OF ELECTROMAGNETIC RADIATION FROM NON-SPHERICAL OPTICALLY ANISOTROPIC TARGETS WITH AXIAL SYMMETRY Ph.D. Thesis**
Robert Orson Dell 1978 216 p
Avail: Univ. Microfilms Order No. 7814333

A method is proposed that will allow for a wide variety of target shapes and will allow the incoming radiation to be incident at any arbitrary angle. The tensor Helmholtz equation is obtained for the E bar and H bar fields. Solutions for these equations are developed using a variational method (Galerkin Technique). Vector partial differential equations are solved. Results obtained using the proposed method are given for the following inhomogeneous targets: (1) an isotropic sphere; (2) an isotropic prolate spheroid; (3) an anisotropic sphere; and (4) an anisotropic prolate spheroid. Dissert. Abstr.

**N78-31323*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE 20/30 GHz SATELLITE SYSTEMS TECHNOLOGY NEEDS ASSESSMENT**
Grady Stevens and David Wright 1978 13 p refs Proposed for presentation at the Intern. Telemetry Conf., Los Angeles, 14-16 Nov. 1978; sponsored by Instrument Soc. of Am.
(NASA-TM-78975; E-9750) Avail: NTIS HC A02/MF A01 CSCL 17B

Rain attenuation in the 20/30 GHz bands, and the resultant impact on system user costs were estimated for a variety of satellite communication system concepts. Results of previous and current NASA Lewis contractual and in-house studies on system design are reported as well as market studies conducted to evaluate the concepts and test their relevancy against forecasted market needs. The 20/30 GHz bands appear attractive economically and, with certain technology, appear to offer a virtually unlimited spectrum resource. This attractiveness is especially relevant to high density trunking where there is sufficient traffic to justify dual-station site diversity. A.R.H.

**N78-31324#** Institute for Telecommunication Sciences, Boulder, Colo.
**PROPAGATION MODEL (0.1 TO 20 GHz) EXTENSIONS FOR 1977 COMPUTER PROGRAMS**
G. D. Gierhart and M. E. Johnson May 1978 90 p refs
(Contracts DOT-FA74WAI-424; DOT-FA68WAI-145)
(AD-A055605; FAA-RD-77-129) Avail: NTIS HC A05/MF A01 CSCL 20/14

Methods used in the 1977 extensions of the propagation model incorporated into computer programs for propagation and interference analysis (0.1 to 20 GHz) are described. These extensions to the 1973 Model allow the programs to be used for a wider variety of problems such as those involving air/air or air/satellite propagation. Method descriptions are confined to mathematical formulations for modifications to the 1973 Model, and do not include program listings or flow charts. A detailed description of the 1973 Model, including program listings, is provided. Capabilities of the 1977 computer programs are mentioned, but not discussed in detail. G.Y.

**N78-31325#** National Aviation Facilities Experimental Center, Atlantic City, N. J.
**TEST AND EVALUATION OF AIR/GROUND COMMUNICATIONS ANTENNAS Final Report, Jan. - Dec. 1977**
James J. Coyle Jun. 1978 130 p
(AD-A056148; FAA-NA-77-39) Avail: NTIS

HC A07/MF A01 CSCL 17/7

Data from the evaluation and analysis of a select group of very high frequency (VHF) and ultrahigh frequency (UHF) air/ground (A/G) communication antennas are presented. Antenna patterns, gain, and voltage standing wave ratio measurements were made at the National Aviation Facilities Experimental Center (NAFEC) antenna range on both Federal Aviation Administration (FAA) specified and commercially available off-the-shelf antennas. These antenna data show that improved A/G communications coverage can be obtained with some of the commercially available antennas. G.G.

**N78-31326#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**A RANDOM POINT PROCESS MODEL FOR ATMOSPHERIC RADIO NOISES M.S. Thesis**

Steven D. Hettinger Mar. 1978 99 p refs

(AD-A055123; AFIT/GE/EE/78-3) Avail: NTIS HC A05/MF A01

The physical processes causing atmospheric radio noise in the very-low frequency communication channel are examined. The return strokes from lightning discharges are found to be the major source of the noise. A survey of empirical noise models is presented. The models are compared in terms of their ability to match the measured first order statistics from CCIR Report 322. While all of these models have advantages and disadvantages, it is observed that all are inadequate to evaluate the performance of known receivers or to specify the optimal receiver structure. This results because empirical noise models give no information about the higher order statistics of the noise. A new model for atmospheric radio noise is developed. This model is a random process model that is based on the physical processes causing the noise. Higher order statistics of the noise can be determined, at least in principle, from this type of model. The model consists of the sum of two compound Poisson processes. The first order statistics from this model are compared to the measured statistics from CCIR Report 322. Based on this, the model is found to be a valid representation for atmospheric radio noise in the very-low frequency channel. Author (GRA)

**N78-31327#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**PERFORMANCE ANALYSIS OF CONTINUOUS-PHASE FREQUENCY SHIFT KEYING MODULATION IN ATMOSPHERIC NOISE M.S. Thesis**

Kenneth Roger Olson Dec. 1977 56 p refs

(AD-A055194; AFIT/GE/EE/77-33) Avail: NTIS HC A04/MF A01 CSCL 17/2

Continuous phase frequency shift keying (CPFSK) is potentially an attractive modulation scheme with performance better than PSK in Gaussian noise. The optimum coherent M-ary CPFSK receiver has been developed for operation in Gaussian noise. In this report the optimum receiver performance is evaluated assuming operation at very low frequencies. Atmospheric noise is the most prevalent interference when operating at very low frequencies. An analytic amplitude probability distribution (APD) function is developed that closely approximates the Crichlow atmospheric noise APD model which is based on empirically measured data. The analytic expression for the APD was developed by combining a Rayleigh and a lognormal density and obtaining the corresponding distribution function. By correctly choosing values for two parameters in the distribution, it approximates the atmospheric noise APD for various Vd ratios. The performance of the optimum coherent M-ary CPFSK receiver was evaluated for $m=4$ and $n=3$ operating in atmospheric noise with specific Vd ratios (4 and 5). The evaluation consists of finding a probability of error bound for a sub-optimum receiver, which is valid for high signal-to-noise ratios (SNR). GRA

**N78-31328#** American Electronic Labs., Inc., Lansdale, Pa.

**WALSH ADAPTIVE FILTER Final Technical Report, 2 Jun. 1976 - 7 Dec. 1977**

John F. Hurst Apr. 1978 68 p refs

(Contract F30602-76-C-0299)

(AD-A055170; RADC-TR-78-82) Avail: NTIS HC A04/MF A01 CSCL 17/2

This report describes a technique and equipment for detecting pulsed signals in a high noise environment. The performance of this technique approaches matched filter techniques for signals where the pulse parameters are not known a-priori. The purpose of this program was to develop an exploratory development model of a system to detect the presence of low SNR signals, on a single pulse-by-pulse basis. The technique chosen for this program was the use of the Walsh Transform as the basis for a two transform digital filter. This technique had previously been demonstrated both in software and in breadboard hardware form by AEL as a result on in-house IR and D programs. This program was to further develop the technique and to fabricate a unit suitable for test and evaluation purposes against a variety of potential applications. The system name, Walsh Adaptive Filter (WAF), was derived from the use of a Walsh transform to adaptively filter signals of varying pulse widths and repetition rates. An exploratory development model was fabricated, tested and delivered to RADC. GRA

**N78-31329#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**AN ALGORITHM FOR DETERMINING SPEECH INTELLIGIBILITY M.S. Thesis**

Wayne R. Beeson Dec. 1977 63 p refs

(AF Proj. 7071-00-12)

(AD-A055236; AFIT/GE/EE/77-9) Avail: NTIS HC A04/MF A01 CSCL 05/8

A method of predicting speech intelligibility using computer algorithms is presented. Diagnostic Rhyme test number four was used to measure speech intelligibility using a subjective listener test and these results were used as a basis for comparison with the intelligibility predictions made by the computer algorithm. An audio recording of a speaker reading the Diagnostic Rhyme test was made. This recording was run through a General Electric radio system and varying amounts of noise were added. The output of the radio system was recorded, providing a copy of the input word corrupted by both additive noise and radio system distortion effects. Both the input recording and the noisy output recording were digitized by sampling the analog waveforms at a 10 kilohertz rate. These digital samples were converted to a frequency format by windowing the time samples with a rectangular window 128 time samples in length and processing them using Fast Fourier transform techniques. GRA

**N78-31330#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**EVALUATION OF COHERENT FSK PERFORMANCE IN ATMOSPHERIC RADIO NOISE M.S. Thesis**

Allen L. Nejezchleb Dec. 1977 48 p refs

(AD-A055237; AFIT/GE/EE/77-32) Avail: NTIS HC A03/MF A01 CSCL 17/2

It is the purpose of this thesis to evaluate the performance of a continuous frequency shift keying (CFSK) communications system operating in an ARN channel. Beckmann's model for the amplitude probability distribution (PDF) of the envelope voltage for ARN is used in the analysis. Beckmann's model provides a theoretical foundation for an empirical APD compiled by Crichlow. The parameters for Beckmann's model are determined which give APD curves that correspond to Crichlow's statistics for Vd ratios of 4 and 5. The marginal density for the in-phase component of ARN is derived from Beckmann's noise model. The performance of a binary CFSK detector operating in an ARN channel is calculated using the very low frequency/low frequency derived in phase density. The M-ary performance is also calculated for M equal to 3 and 4. A comparison is made to experimental CFSK performance data. The theoretical performance curves provide a tight upper bound on the probability of error for the experimental performance. The conclusion is reached that the probability of error for ARN does not decrease significantly with an increase in signal-to-noise ratio. Author (GRA)

**N78-31331#** Naval Ocean Systems Center, San Diego, Calif. Dept. of Fleet Engineering.

**MODIFIED MAXIMUM ENTROPY SPECTRAL ANALYSIS OF BANDLIMITED SIGNALS IN LOWPASS NOISE Final Report, Jan. 1977 - Mar. 1977**

S. T. Alexander Apr. 1978 20 p refs

(XF11101100)

(AD-A055258; NOSC/TR-231) Avail: NTIS HC A02/MF A01 CSCL 09/4

The mean properties of the modified maximum entropy method (MEM) spectral estimator incorporating variable delay are developed for the case of a bandlimited (BL) complex signal in lowpass noise. Asymptotic cases of long filter length and degeneration to the white noise are examined in detail. The modified MEM is shown to reproduce the input spectrum (to within a scaling factor) for Delta = unity and to provide a spectral whitening function as Delta grows very large. Additionally, examples of spectral distortion for Delta greater than unity are shown and qualitatively explained. GRA

**N78-31332#** Louisiana State Univ. and A&M Coll., Baton Rouge. Inst. of Coastal Studies.

**HIGH-FREQUENCY TECHNIQUES AND OVER-THE-HORIZON RADAR IN COASTAL RESEARCH**

William J. Wiseman, Jr., Stephen P. Murray, and Harry H. Roberts 1977 13 p refs

(Contract N00014-75-C-0192; NR Proj. 388-002)

(AD-A054846; TR-267) Avail: NTIS HC A02/MF A01 CSCL 17/9

In order to telemeter environmental data from remote shelf waters inexpensively, radio transmitters in the 2- to 6-megahertz (MHz) band are attached to freely drifting drogues. Bearing angles to the drogues are obtained at shore bases by using directional antennas to receive the ground wave transmissions from the drogues. Drogues have been tracked using this system in a variety of coastal situations. Mass fluxes determined by this method would have been prohibitively expensive to delineate with current meters. The system has also been used to telemeter sea surface temperature to nearby shore stations as well as over extended distances. Author (GRA)

**N78-31333#** State Univ. of New York at Buffalo, Amherst. Dept. of Electrical Engineering.

**RADAR IMAGE MODELING AND PROCESSING FOR REAL-TIME RF SIMULATION Final Report, 20 Nov. 1976 - 19 Feb. 1978**

Anil K. Jain and Jaswant R. Jain 15 Mar. 1978 65 p refs (Grant DAAG29-77-G-0044)

(AD-A055060; ARO-14653.5-R-EL) Avail: NTIS HC A04/MF A01 CSCL 17/9

The problem of modeling and processing radar images for tracking applications has been considered. Digital simulation experiments have been carried out for area correlation of a reference target image with on-board radar acquired images. Effects of misregistrations of radar height (scaling) and orientation (rotation) and those of high pass filtering of images have been studied. Use of image models based on finite difference approximation of partial differential equations (PDEs) has also been studied. Author (GRA)

**N78-31334#** Harris Corp., Melbourne, Fla. Electronic Systems Div.

**BROADBAND MODEM II Final Technical Report**

Bruce E. Gillingham and Robert C. Davis Apr. 1978 162 p (Contract F30602-76-C-0434; AF Proj. 4519)

(AD-A055269; RADC-TR-78-92) Avail: NTIS HC A08/MF A01 CSCL 09/5

The objective of this program was to optimize the techniques developed on the previous contract (Contract F30602-74-C-0263) from a cost and performance point of view and to implement an experimental modem suitable for extended test at RADC providing bandwidth efficient signalling for the line-of-sight microwave system. Specifically, spectral efficiency compliant with FCC Docket 19311 was required. A bit error rate of 5 x 10 to the minus ninth power at an Eb/No of 22 dB for two bits/hertz of RF bandwidth operation or at an Eb/No of 16 dB for one bit/hertz of RF bandwidth operation was desired. An experimental modem was constructed and successfully tested, both in the laboratory and at RADC. All design requirements were met. Most notably, the performance goal of emission requirements as described in FCC Docket 19311 was met. The acquisition performance objective of 20 ms for a frequency off-set of 20 kHz was met, as was the performance objective of 5 x 10 to the minus ninth power bit error rate at an Eb/No of 16 db for one bit/hertz operation. The design objective of a 5 x 10 to the minus ninth power bit error rate at an Eb/No of 22 db for two bits/hertz operation was exceeded in back-to-back tests and was within 0.6 db for a group-delay compensated LC8D radio. Author (GRA)

**N78-31335#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**ANALYSIS OF MONOPOLE ANTENNA ARRAYS ON CYLINDERS BY THE GEOMETRICAL THEORY OF DIFFRACTION M.S. Thesis**

Bruce A. Thieman Dec. 1977 77 p refs

(AD-A055197; AFIT/GE/EE/77-41) Avail: NTIS HC A05/MF A01 CSCL 17/2

Using the Geometrical Theory of Diffraction (GTD) the fields due to a monopole array mounted on an aircraft near the top or bottom were analyzed. The aircraft was modeled in its most basic form; an infinitely long elliptical cylinder. The aircraft cross-section at the location of the antenna was modeled as a 2 meter by 4 meter ellipse. The frequency band of operation was 250 mHz to 400 mHz with an average wavelength assumed of 1 meter. The three element array was found to have a beam broadening effect when compared to the array mounted on an infinite ground plane. The array exhibited a poor potential to form a single major lobe in its antenna pattern but had a high mobility of pattern nulls. Author (GRA)

**N78-31336#** Naval Research Lab., Washington, D. C.

**THE STEERING PROBLEM FOR THE MIRROR-SCAN TRACKING SYSTEM. PART 1: THE STOP-GO-STOP PROCEDURE Final Report**

William B. Gordon 4 May 1978 19 p

(RR0140941; SF32399491)

(AD-A055125; NRL-8227-Pt-1) Avail: NTIS HC A02/MF A01 CSCL 17/9

Tracking radar systems are being designed which use a lightweight mirror to steer the radar beam. Such systems can track several targets simultaneously, and the steering problem is to find the beam motion which covers a given collection of targets with minimum update time. In this report it is shown how the steering problem is a control-theoretic problem on the sphere. The suboptimal stop-go-stop solutions are discussed, and it is determined that the proposed Mirror Scan system can simultaneously track at least seven targets in a half-hemisphere with an update time of less than 1 second. Author (GRA)

**N78-31337#** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

**ON THE EPISTEMOLOGICAL STATUS OF SEMANTIC NETWORKS**

Ronald J. Brachman Apr. 1978 73 p refs Submitted for publication

(Contracts N00014-77-C-0378; N00014-77-C-0371)

(AD-A055048; BBN-3807) Avail: NTIS HC A04/MF A01 CSCL 05/7

This paper examines in detail the history of a set of network-structured formalisms for knowledge representation - the so-called semantic networks. While these nets have for the most part retained their basic associative nature, their primitive representational elements have differed significantly from one project to the next. These differences in underlying primitives are symptomatic of deeper philosophical disparities, and a set of five significantly different levels at which networks can be understood are discussed. One of these levels, the epistemological, or knowledge-structuring, level, has played an important implicit part in all previous notations, and is here made explicit in a way that allows a new type of network formalism to be specified. This new type of formalism accounts precisely for operations like individuation of description, internal concept structure in terms of roles and interrelations between them, and structured inheritance. GRA

**N78-31338#** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

**SPEECH COMPRESSION AND EVALUATION Final Report, Dec. 1974 - Dec. 1977**

R. Viswanathan, John Makhoul, and A. W. F. Huggins Apr. 1978 245 p refs

(Contract MDA903-75-C-0180; ARPA Order 2935)

(AD-A055019; BBN-3794) Avail: NTIS HC A11/MF A01 CSCL 17/2

This report describes work in the past three years on data compression and quality evaluation of digital speech. Linear

predictive coding (LPC) techniques with the overall objective of digitally transmitting high quality speech at the lowest possible average data rates over packet-switched communication media were developed and implemented. Major techniques reported include: covariance lattice method of linear prediction analysis, adaptive lattice methods, linear predictive spectral warping, improved quantization of LPC parameters, variable frame rate transmission of LPC parameters based on a functional perceptual model of speech, and a mixed-source model for LPC synthesizer to produce more natural-sounding speech. Also, a reliable method for measuring subjective speech quality was developed. This method was employed to formally demonstrate the quality improvements provided by our speech analysis/synthesis techniques as well as for studying speech quality as a function of LPC parameters. As subjective procedures are generally expensive and time-consuming, several objective procedures for speech quality evaluation were developed and tested. The results from these objective procedures were found to be highly correlated to the corresponding subjective quality judgments. Another highlight of the work is the development of a speech processing computer facility with the ultimate goal of transmitting narrowband speech in real time over the ARPA Network. Author (GRA)

**N78-31339#** Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.

**UHF ADAPTIVE ARRAY DEVELOPMENT PROGRAM Final Report**

D. D. Effinger, W. R. Jones, W. R. Masenten, T. W. Miller, and W. G. Tees 1 Jul. 1977 127 p refs
(Contract N00173-76-C-0353)
(AD-A055942; FR77-14-763) Avail: NTIS HC A07/MF A01 CSCL 17/4

The prime objective of the UHF adaptive array processor program was to develop an adaptive array to provide rejection of interference in Naval communications systems. The major goals were: maximizing the signal-to-noise and signal-to-interference ratios, suppressing jammers over a 10 MHz bandwidth, operating with any four-element antenna array, and accommodating a wide range of jammer and signal waveforms. GRA

**N78-31340#** Science Applications, Inc., Berkeley, Calif.

**A WIRE PASSING BY A CIRCULAR APERTURE IN AN INFINITE GROUND PLANE Final Report**

K. S. H. Lee (Dikewood Corp., Los Angeles) and F. C. Yang (Dikewood Corp., Los Angeles) Jun. 1977 31 p refs
(Contract F29601-76-C-0125)
(AD-A055583; AFWL-TR-77-52) Avail: NTIS HC A03/MF A01 CSCL 20/14

A procedure is given to calculate the elements of an equivalent circuit representation of an aperture in an infinite ground plane for a cable passing by the aperture and parallel to the ground plane. For an electrically small hole whose linear dimensions are much smaller than the shortest distance between the hole's center and the wire, explicit simple working formulas are obtained for all the elements (impedances and generators) in the equivalent circuit. When the restriction on the hole's size relative to the distance from the wire is removed, explicit but somewhat complicated expressions for the equivalent generators are derived. These expressions are plotted against various pertinent length parameters of the geometry of the problem. Author (GRA)

**N78-31341#** Syracuse Univ., N. Y. Dept. of Electrical Computer Engineering.

**METHOD OF MOMENT THIN WIRE COMPUTER PROGRAM COMPARISONS FOR COMPLEX STRUCTURES AND COARSE ACCURACY**

Jose Perini and Harvey K. Schuman May 1978 78 p refs
(Contract F30602-75-C-0121)
(AD-A055759; RADC-TR-78-106) Avail: NTIS HC A05/MF A01 CSCL 09/5

Recently developed numerical methods have been applied successfully to performance prediction of antennas in complex scattering environments. The general framework for these techniques, at frequencies for which the antenna is at most a few wavelengths, is the method of moments (moment method) as set forth by Harrington (Harrington 1968). Many computer programs have been developed, based on the moment method. A number of them are applicable to solving antenna problems of quite arbitrary geometries. In particular the programs based upon thin-wire modeling are applicable. Not all antennas are collections of thin wires, however. Hence, there are two concerns regarding these methods: (1) the accuracy of the model, and (2) the accuracy of the analysis of the model. An accurate model is one which exhibits all important aspects of the actual antenna. This accuracy can be gauged either by (1) comparison with experiment or other analysis if results from these exist, or (2) continuously increasing the complexity of the model (add wires, for example) until computed parameters such as driving point impedance, radiation pattern, or current show little change. Gauge (2) is a convergence test. An accurate model analysis, on the other hand, is not related to the relevance of the model, but rather to the accuracy with which an analytical tool predicts important model parameters. GRA

**N78-31342#** Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

**SPACE-TIME SIGNAL PROCESSING OF RADAR RETURNS Phase Report, 1 May - 30 Nov. 1977**

George R. Copper and Clare D. McGillem Apr. 1978 146 p
(Contract F30602-75-C-0082)
(AD-A055758; RADC-TR-78-89) Avail: NTIS HC A07/MF A01 CSCL 17/9

Radar returns from complex targets that are large compared to the wavelength of the radar signal are composed of reflections from a number of scattering points on the surface of the target. Although the target may contain a large number of scattering points, experience indicates that at any particular instant of time the major portion of the returned signal energy comes from only a few such points. These predominant reflections combine at the receiving point with phases that are random because the range differences between reflecting points are random and critically dependent upon the aspect angle of the target. As a consequence of the random phase differences, the total signal power observed by the receiver is also random and fluctuates drastically around some average value as a result of changes in target attitude. The average value of power is simply the sum of the powers from the individual reflecting points, and this situation is referred to here as noncoherent signal summation. If the return signal from each of the predominant reflecting points had the same phase as all the other signals, then the voltages in the receiver would add rather than the powers. The resulting received signal power is then proportional to the square of the sum of the voltages and will always be larger than the average power obtained by noncoherent signal summation. GRA

**N78-31343#** State Univ. of New York at Buffalo, Amherst. Dept. of Electrical Engineering.

**TEPER TECHNICAL EVALUATION PROGRAM EVALUATION AND RESTRUCTURING**

R. L. Feik May 1978 97 p refs
(Contract F30602-75-C-0122)
(AD-A055757; RR-2-77; RADC-TR-78-121) Avail: NTIS HC A05/MF A01 CSCL 17/2

The original goals of the Technical Evaluation Program (TEP) were lofty and benefits were intended for every facet of the DCS from day-to-day O and M through system characterization and engineering. There are those who question how well the TEP has met these goals. This report examines this issue and quantizes the cost benefits by tabulating the TEP numerous outputs and by estimating the cost of contracts that would have been required to produce the equivalent output. The conclusion is that the TEP has contributed dramatically to the DCS, but may have been biased toward O and M activities. This report examines the present status of the TEP, and discusses the constraints and impediments that raise the cost and limit the effectiveness and productivity. The study investigates possible future program courses to accommodate the enumerated hindrances, to sharpen the goals of a future TEP, and to reduce the cost while increasing the demonstrable outputs. A future TEP configuration is defined, including: a re-oriented and more definitive set of objectives, a reformulated approach and analysis concept, and a specific set of output products to be derived to support the DCA Quality Assurance program as described in the DCA Circular 310-70-57, and also to provide the DCA Engineering system characterization and data base. GRA

**N78-31344#** Naval Research Lab., Washington, D. C.
**UHF SCINTILLATION CHARACTERISTICS AS OBSERVED FROM KEFLAVIK, ICELAND Interim Report, Oct. 1976 - Jul. 1977**
J. M. Goodman, P. L. Watkins, C. G. Myers, and R. Hogg Feb. 1978 87 p
(AD-A055760; NRL-8160) Avail: NTIS HC A05/MF A01 CSCL 04/1

This is a study of characteristics of low-elevation and high-latitude scintillation. Transmissions at 360 MHz from ATS-6 were received at Keflavik, Iceland, during June, September, and October and were analyzed to extract information related to the amplitude scintillation introduced by ionospheric and/or tropospheric inhomogeneities. This report describes the data acquisition and processing procedures and some interim results. The overall average scintillation index S sub 4 was found to be 0.15, and the 1-99% fading range was about 3.5 db. The scintillation was found to be more strongly controlled by magnetic than solar activity, as expected. The amplitude statistics were found to be non-Rayleigh, and the smaller scintillation levels observed in this study were roughly approximated by the Nakagami-m model. The power spectra exhibited a power-law rolloff from a corner frequency of 0.067 Hz with an index of -2 on the average. Generally 50% of the scintillation power was provided by frequencies less than 0.03 Hz, and the fade-duration and fade-interval distributions were typically exponential. GRA

**N78-31345#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**THE EFFECT OF POLARIZATION DIVERSITY ON RECEIVING SYSTEMS M.S. Thesis**
Meir Lavi Dec. 1977 110 p refs
(AD-A055450; AFIT/GE/EE/77-26) Avail: NTIS HC A06/MF A01 CSCL 17/4

The use of polarization diversity process requires the derivation of a mathematical system model to allow evaluating the effects of this process, employed by a jammer or by a threatened radar, upon jamming effectiveness. The system model consists of two orthogonal linear antennas controlled by a random process in amplitude and phase. The expected value of the received power due to interference is related to the autocorrelation of the received signal. The received power is obtained in the frequency domain from the spectral behavior of the total polarization diversity processes employed by both the jammer and radar and the spectral characteristics of the transmitting and receiving systems. The spectral behavior of the total polarization diversity process is constructed by the convolution between the polarization diversity processes of both the jammer and radar. The spectrum of the polarization diversity is spread in a convolution manner by the transmitter spectrum. This convolved spectrum contributes to the expected value of the received power only within the bandwidth of the receiving system. It is concluded that for several typical scenarios polarization diversity is an effective jamming technique. Author (GRA)

**N78-31346#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Flugfunk und Mikrowellen.
**BACKUS-GILBERT INVERSION OF ELECTROMAGNETIC PROPAGATION PHENOMENA FOR REMOTE PROBING OF THE ATMOSPHERE**
K. G. Yadava 10 Dec. 1977 41 p refs
(DLR-IB-551-76/21) Avail: NTIS HC A03/MF A01

An attempt was made to develop a suitable method to invert noisy satellite tracking data for the radio refractive index with the aim of remote probing the atmosphere and achieving higher accuracy in the determination of satellite orbits. The Backus-Gilbert method was applied with modifications to get meaningful results by inverting computer simulated range data. Author (ESA)

**N78-31347#** Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires at Geophysiques.
**REVIEW OF METHODS FOR DESCRIPTION OF RANDOM TRANSMISSION CHANNELS APPLICATIONS TO IDENTIFICATION AND OPTIMISATION OF DETECTION AND TRANSMISSION PROCESSES**
J. L. Lacoume and G. Jourdain 13 Jul. 1977 31 p refs Submitted for publication
(CEPHAG-35/77) Avail: NTIS HC A03/MF A01

A theoretical means to describe linear systems, whether stationary or not, is presented in connection with practical methods of identification. In the different approaches used to represent channel propagation, the systemic approach leading to the representation of the system by a stochastic function is emphasized: impulse response in the stationary case; functions of two variables in the nonstationary case. These representations will be characterized by their moments in the external approach or by a structural, Kalman type, representation in the internal approach. The study is performed for two-point-linking channels and for spatial channels (extended sources and receivers). Some applications resulting from laboratory simulations or from experimentations in natural media are presented. Author (ESA)

**N78-31348#** National Physical Lab., Teddington (England). Div. of Electrical Science.
**A THEORETICAL AND EXPERIMENTAL STUDY OF JOSEPHSON FREQUENCY MIXERS FOR HETERODYNE RECEPTION IN THE SUBMILLIMETRE WAVELENGTH RANGE Final Report**
T. G. Blaney, comp. Paris ESA Mar. 1978 293 p refs
(Contract ESTEC-2337/74-PP)
(ESA-CR(P)-1063) Avail: NTIS HC A13/MF A01

The present status of Josephson-effect mixers for use in the 1 to 0.1 mm wavelength range in heterodyne receivers for astronomical observations from spacecraft is surveyed. The theory of Josephson mixers when used with an external clock oscillator is discussed. Experimental tests, mainly at 450 GHz using niobium point contact Josephson mixers mounted in fundamental mode waveguide cavities, are described. The best overall receiver noise temperature (double sideband) was 2100 K but 1000 K appears to be possible. Experiments at frequencies up to 89.1 GHz are also described. A general survey of the outstanding problems of building field usable Josephson receivers is presented. The only major outstanding problem is to combine ruggedness with suitable electrical characteristics. In conclusion, overall receiver noise temperatures of a few hundred K at 1 mm, rising to several thousand K at about 0.3 mm appear probable. ESA

**N78-31349#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Flugfunk und Mikrowellen.
**SYNTHETIC APERTURE RADAR (SAR) SYSTEM LIMITATIONS DUE TO PHASE ERRORS [SYSTEMBEGRENZUNGEN DURCH PHASENFEHLER BEIM RADAR MIT SYNTHETISCHER APERTUR (SAR)]**
C. Boesswetter 1 Nov. 1977 45 p refs In GERMAN Report will also be announced as translation (ESA-TT-481)
(DLR-IB-551-77/2) Avail: NTIS HC A03/MF A01

The origin of phase errors and the influence of the errors on the performance of SAR, with emphasis on quadratic phase error components, are discussed. The resolution loss due to acceleration and velocity errors was estimated, both for aircraft and for satellite platforms. It was found that high resolution and long range airborne SAR systems are limited by quadratic phase errors, satellite borne SAR systems are not limited by phase errors because the planned resolution remains far below the existing boundary values. ESA

**N78-31350#** Marconi Co. Ltd., Chelmsford (England). Theoretical Support Services.
**LINK ANALYSIS PROGRAM LINKAN. VOLUME 1: THEORETICAL AND PROGRAMMER'S MANUAL**
P. G. Wright and B. G. West Paris ESA Apr. 1978 223 p refs 2 Vol.
(Contract ESA-3259/77-NL-AK)
(ESA-CR(P)-1083-Vol-1) Avail: NTIS HC A10/MF A01

The theory and programming methods used in developing the program LINKAN, which performs noise analysis of fading satellite communication links are described. The analysis includes the treatment of non-linear satellite amplifiers, fading due to weather effects and aerial pointing losses, and the relation between the downlink noise and the downlink weather fading. The result is the distribution of the overall signal to noise ratio. Author (ESA)

**N78-31351#** Marconi Co. Ltd., Chelmsford (England). Theoretical Support Services.
**LINK ANALYSIS PROGRAM LINKAN. VOLUME 2: USER'S MANUAL**
P. G. Wright and B. G. West Paris ESA Apr. 1978 56 p 2 Vol.
(Contract ESA-3259/77-NL-AK)
(ESA-CR(P)-1083-Vol-2) Avail: NTIS HC A04/MF A01

The use of the program 'LINKAN' to perform noise analysis on satellite communications links is described featuring a fading uplink and downlink, and a non-linear amplifier in the satellite. Fade distributions are specified numerically, or as certain standard distributions, and may be specified by aerial pointing error distributions together with the antenna gain. The variation of downlink noise with weather conditions is allowed for. The result is the distribution of the overall signal to noise ratio.
Author (ESA)

**N78-31352#** National Technical Information Service, Springfield, Va.
**TELECOMMUNICATION: ECONOMIC STUDIES. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - May 1978**
William E. Reed Jun. 1978 252 p Supersedes NTIS/PS-77/0530; NTIS/PS-76/0380; NTIS/PS-75/400
(NTIS/PS-78/0581/5; NTIS/PS-77/0530; NTIS/PS-76/0380; NTIS/PS-75/400) Avail: NTIS HC $28.00/MF $28.00 CSCL 17B

Research on economic evaluations of the telecommunications industry is cited. Communication satellites, common carriers, cable television, telephone systems, and television systems are all covered in the bibliography. Economic studies of the foreign telecommunications industry are included.
GRA

**N78-31281#** Royal Signals and Radar Establishment, Malvern (England).
**THE ROLES FOR CCD AND SAW IN SIGNAL PROCESSING**
J. B. G. Roberts *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 16 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31282#** Rome Air Development Center, Griffiss AFB, N.Y. Deputy for Electronic Technology.
**MATERIAL CHOICE FOR OPTIMUM SAW DEVICE PERFORMANCE**
Robert M. OConnell, Andrew J. Slorodnik, Jr., and Paul H. Carr *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 19 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31285#** Sperry Research Center, Sudbury, Mass.
**SIGNAL PROCESSING WITH A REFLECTIVE DOT ARRAY (RDA)**
L. P. Solie and H. VanDeVaart *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 4 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31290#** Rockwell International Corp., Anaheim, Calif.
**A HYBRID SAW/CCD SIGNAL PROCESSOR**
William H. Conway and Dirk R. Kloss (Army Electronic Warfare Lab., Fort Monmouth, N. J.) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 8 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31298#** TRW Defense and Space Systems Group, Redondo Beach, Calif.
**LSI VIDEO COMPRESSION AND COMPUTATIONAL MODULES UTILIZING DIGITAL CHARGE COUPLED DEVICES**
R. A. Allen, D. J. Spencer, and C. S. Miller *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 10 p refs (For primary document see N78-31279 22-31)
(Contract N00014-74-C-0068)
Avail: NTIS HC A21/MF A01

**N78-31300#** Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).
**SAW FILTER APPLICATION FOR PHASED ARRAY RADAR**
W. Sander and W. H. Haydl (Inst. fuer Angew. Festkorperphysik der Fraunhofer-Ges.) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 11 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31307#** AEG-Telefunken, Ulm (West Germany).
**A CCD MEMORY CHIP FOR RADAR IMAGE PROCESSING**
K. Rodde, E. Stein, and H.-J. Wulf *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 10 p refs Sponsored by the Federal Ministry of Research and Technology, the Federal Republic of Germany (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31308#** Carleton Univ., Ottawa (Ontario).
**ELECTRO-OPTICAL PROCESSING OF SIGNALS AND IMAGES**
D. Roy, M. A. Copeland, and C. H. Chan *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 9 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31314#** Thomson-CSF, Malakoff (France).
**APPLICATIONS OF PIEZOELECTRIC CONVOLUTERS TO RADAR SIGNAL PROCESSING [APPLICATIONS D'UN CONVOLUTEUR PIEZOELECTRIQUE AU TRAITEMENT DU SIGNAL RADAR]**
P. Anthoward and T. Beauvais *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 17 p refs In FRENCH (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31315#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**OPERATION OF SAW REFLECTIVE ARRAY PULSE COMPRESSORS IN A HIGH PERFORMANCE RADAR WITH MINUS 0.4 METER RANGE RESOLUTION**
W. J. Ince, S. C. Cottrill (RCA, Marshall Islands), and P. Gelzinis (RCA, Marshall Islands) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 16 p refs Sponsored in part by the US Army (For primary document see N78-31279 22-31)
(Contract F19628-76-C-002)
Avail: NTIS HC A21/MF A01

**N78-31316#** Southampton Univ. (England).
**A NOVEL SIGNAL INTEGRATOR USING CCDs**
C. P. Trayner, P. C. T. Roberts, R. G. Taylor (Admiralty Surface Weapons Establishment, Portsmouth, Engl.), J. D. E. Beynon, and G. G. Bloodworth *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 12 p refs Sponsored by Ministry of Defense (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31317#** Thomson-CSF, Bagneux (France).
**CCD DELAY LINES FOR THE PROCESSING OF A RADAR SIGNAL: APPLICATION TO AN MTI [LIGNE A RETARD DUTYPE CCD POUR TRAITEMENT DU SIGNAL RADAR APPLICATION A UN MTI]**

J. L. Berger, D. Reneric (STTA, Paris), and R. Vanhove *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 23 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31318#** Standard Telecommunication Labs. Ltd., Harlow (England).
**A CCD DELAY LINE DOPPLER ANALYSER**
J. D. Jackson, G. R. Adams, and J. S. Heeks *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 8 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31319#** Kaiserslautern Univ. (West Germany).
**COMBINED ACQUISITION AND FINE SYNCHRONIZATION SYSTEM FOR SPREAD SPECTRUM RECEIVERS USING A TAPPED DELAY LINE CORRELATOR**
W. P. Baier, M. Pandit, and H. Grammuller (Siemens AG, Munich) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 12 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

# 33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

**N78-31353*#** TRW Defense and Space Systems Group, Redondo Beach, Calif.
**MULTI-KW dc DISTRIBUTION SYSTEM TECHNOLOGY RESEARCH STUDY Final Report**
S. G. Dawson Jul. 1978 119 p refs
(Contract NAS8-31719)
(NASA-CR-150789; Rept-29817-6001-TU-00) Avail: NTIS HC A06/MF A01 CSCL 09C

The Multi-KW DC Distribution System Technology Research Study is the third phase of the NASA/MSFC study program. The purpose of this contract was to complete the design of the integrated technology test facility, provide test planning, support test operations and evaluate test results. The subjet of this study is a continuation of this contract. The purpose of this continuation is to study and analyze high voltage system safety, to determine optimum voltage levels versus power, to identify power distribution system components which require development for higher voltage systems and finally to determine what modifications must be made to the Power Distribution System Simulator (PDSS) to demonstrate 300 Vdc distribution capability. G.Y.

**N78-31354*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**NUMERICAL PROCEDURE TO DETERMINE GEOMETRIC VIEW FACTORS FOR SURFACES OCCLUDED BY CYLINDERS**
Patricia L. Sawyer. Sep. 1978 48 p refs
(NASA-TM-78740; L-12286) Avail: NTIS HC A03/MF A01 CSCL 20D

A numerical procedure was developed to determine geometric view factors between connected infinite strips occluded by any number of infinite circular cylinders. The procedure requires a two-dimensional cross-sectional model of the configuration of interest. The two-dimensional model consists of a convex polygon enclosing any number of circles. Each side of the polygon represents one strip, and each circle represents a circular cylinder. A description and listing of a computer program based on this procedure are included in this report. The program calculates geometric view factors between individual strips and between individual strips and the collection of occluding cylinders. G.Y.

**N78-31355*#** National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
**CONTACT WHISKERS FOR MILLIMETER WAVE DIODES**
A. R. Kerr, J. A. Grange, and J. A. Lichtenberger (Meta-Plate, Charlottesville, Va.) Aug. 1978 37 p refs
(Contract NAS5-24452)
(NASA-TM-79616) Avail: NTIS HC A03/MF A01 CSCL 09A

Several techniques are investigated for making short conical tips on wires (whiskers) used for contacting millimeter-wave Schottky diodes. One procedure, using a phosphoric and chromic acid etching solution (PCE), is found to give good results on 12 microns phosphor-bronze wires. Full cone angles of 60 degrees-80 degrees are consistently obtained, compared with the 15 degrees-20 degrees angles obtained with the widely used sodium hydroxide etch. Methods are also described for cleaning, increasing the tip diameter (i.e. blunting), gold plating, and testing the contact resistance of the whiskers. The effects of the whisker tip shape on the electrical resistance, inductance, and capacitance of the whiskers are studied, and examples given for typical sets of parameters. Author

**N78-31356#** GenRad, Inc., Concord, Mass.
**TRACKING SERVOBRIDGE DETECTOR, VOLUME 1 Final Report**
William J. Riley and William M. Twadell 15 Dec. 1976 134 p
(Contract DAAB07-73-C-0609)
(AD-A055083; Rept-24655-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 14/2

Technical description is given of the Tracking Servobridge Detector in final configuration after passing all of the requirements of MIL-D55361 EL. GRA

**N78-31357#** GenRad, Inc., Concord, Mass.
**TRACKING SERVOBRIDGE DETECTORS, VOLUME 2 Final Report**
William M. Twadell 14 Mar. 1977 77 p
(Contract DAAB07-73-C-0609)
(AD-A055084; Rept-24655-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 14/2

The object of this study is to perform the design, development engineering, fabrication of special tooling and test fixtures, obtain first article approval and establish a pilot line and pilot run for tracking servobridge detectors. Author (GRA)

**N78-31358#** GenRad, Inc., Concord, Mass.
**TRACKING SERVOBRIDGE DETECTORS. VOLUME 3: OPERATION SHEETS Final Report**
William J. Riley and William M. Twadell 15 Dec. 1976 114 p
(Contract DAAB07-73-C-0609)
(AD-A055085; Rept-24655-Vol-3) Avail: NTIS HC A06/MF A01 CSCL 14/2

All of the Operation Sheets are reported that are required to fabricate Gen Rad manufactured components and to assemble and test subassemblies and Tracking Servobridge Detectors. GRA

**N78-31359#** Calspan Corp., Buffalo, N. Y.
**ARRAY SCANNING TECHNIQUES Final Technical Report, 10 Jun. 1976 - 9 Dec. 1977**
Hollis F. Ryan, Roy C. Waas, Phillip G. Pflueger, and Leland D. Hamilton Apr. 1978 196 p refs
(Contract F30602-76-C-0294)
(AD-A055176; CALSPAN-ME-5955-X-1; RADC-TR-78-71) Avail: NTIS HC A09/MF A01 CSCL 08/2

The objective of this study was to determine the feasibility of scanning cartographic documents by large, semiconductor linear arrays and by specially shaped geometric arrays. The Calspan flatbed image scanner with its linear array sensor was used with supporting computer software to scan and process small sections of the USAF's Cartographic Test Standard (mylar version). The basic properties of the monolithic linear array of silicon photodiodes for the generation of imagery were studied by directly examining the imagery output of the scanner. Two geometric

arrays were studied by simulating their aperture geometries with software in a PDP-9 computer. Analysis of the imagery output of the flatbed scanner showed that the linear array produced excellent imagery. Examination of the behavior of the two simulated geometric arrays showed that the line directions found were the ones desired in most cases. Solid state photosensor technology was evaluated. Methods were presented for hardware implementation of geometric array processing algorithms. It was concluded that current array sensing technology is suitable for digitally encoding cartographic documents. Author (GRA)

**N78-31360#** TRW, Inc., Lawndale, Calif. Semiconductor Div.
**MONOLITHIC 20W 2GHz TRANSISTOR AND MONOLITHIC 5W 4GHz TRANSISTOR Quarterly Report, 14 Sep. - 13 Dec. 1977**
George Schreyer Jan. 1978 20 p
(Contract DAAB07-77-C-0431)
(AD-A055249; QR-2) Avail: NTIS HC A02/MF A01 CSCL 09/1

Wire bonding experiments on existing microwave dice were performed to determine optimum bonding configurations for microwave transistors. The results of these experiments guided the design of the active portion of the monolithic 2 GHz device, the L-10. To define a 4 GHz material specification, several lots of 4 GHz dice are being processed. The results of experiments on epitaxial resistivity and profile will guide the specification of PIN epitaxial material for the 4 GHz portion of the program. Author (GRA)

**N78-31361#** RCA Labs., Princeton, N. J.
**REPRODUCIBLE ADHESION TEST FOR SOLDERED THICK-FILM CONDUCTORS Final Report, 30 Jun. 1976 - 30 Jun. 1977**
Thomas T. Hitch 31 Jul. 1977 45 p refs
(Contract N00163-76-C-0287)
(AD-A054971; PRRL-77-CR-38) Avail: NTIS HC A03/MF A01 CSCL 20/3

The need for an adhesion test method that is more reproducible from operator to operator and from laboratory to laboratory is well known in the thick-film industry. The development of such a method was begun at RCA under earlier Naval contracts, and has been completed and tested in detail in this study. Thorough descriptions of two recommended variations of the method, the apparatus required to perform them, and the evaluations made during this study are presented. GRA

**N78-31362#** IIT Research Inst., Annapolis, Md.
**ANALYSIS OF RECEIVER MIXERS Final Report**
Michael A. Maiuzzo Mar. 1978 74 p refs
(Contract F19628-78-C-0006)
(AD-A055283) Avail: NTIS HC A04/MF A01 CSCL 09/4

Procedures are presented for estimating desired and undesired receiver mixer responses. Computer models, developed using the Taylor-Fourier series method to analyze double-balanced-diode and single-diode mixers, are described. Author (GRA)

**N78-31363#** Edgerton, Germeshausen and Grier, Inc., Salem, Mass.
**REPETITIVE SERIES INTERRUPTER 2 Interim Report, Jan. 1976 - Sep. 1977**
David V. Turnquist and Robert Simon Apr. 1978 163 p refs
(Contract DAAB07-76-C-1301; DA Proj. 1L1-62705-AH-94)
(AD-A055253; ECOM-76-1301-6; IR-6) Avail: NTIS HC A08/MF A01 CSCL 09/1

This report documents development work for the Repetitive Series Interrupter, a hydrogen thyratron modified for opening switch operation. Fault current interruption is provided by the magnetically controlled interaction of a hydrogen discharge with a wall surface in a suitably constructed interaction channel. Investigations herein reported measure the effects on interruption of regular and irregular wall surfaces as well as of the tube parameters of pressure and channel length, diameter, and geometry. Successful interruptions of 15 kV, 300 ampere fault pulses have been obtained in various chuted channel geometries using an effective magnetic field energy of 5 joules. Optical observation of the discharge column and a theoretical analysis of the positive column under crossed field conditions have been performed. Author (GRA)

**N78-31364#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**DAMPER WINDING REACTANCE M.S. Thesis**
Richard E. Moore Mar. 1978 54 p refs
(AD-A055199; AFIT/GE/EE/78-5) Avail: NTIS HC A04/MF A01 CSCL 09/1

This thesis was undertaken to develop a simple method for calculating damper winding reactances. Many engineers have published papers developing and presenting methods for calculating the reactances of the synchronous machine, however these papers are written for the engineer who is an expert in this field. These methods require the calculation or knowledge of fluxes, induced currents, voltages and/or other factors. This thesis reduces these methods to equations relating back to machine geometries only, allowing anyone with the geometries to calculate the damper winding reactances of the machine. GRA

**N78-31365#** Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Electrical and Systems Engineering.
**ADAPTIVE KALMAN TYPE ESTIMATION APPLIED TO IMAGE PROCESSING Interim Report**
A. Radpour, V. Ingle, H. Kaufman, and J. Woods Jun. 1978 7 p refs
(Grant AF-AFOSR-3361-77)
(AD-A055827; AFOSR-78-1094TR) Avail: NTIS HC A02/MF A01 CSCL 05/8

Because of the stochastic and nonstationary nature of image processes, an adaptive estimation algorithm is proposed and evaluated for on-line filtering of an image scanned in a raster pattern. This algorithm combines a least squares parameter identification procedure with a two-dimensional reduced update Kalman filter. Results using an image with a 3 db signal to noise ratio indicate that this adaptive algorithm is very effective for image restoration. Author (GRA)

**N78-31366#** Air Force Avionics Lab., Wright-Patterson AFB, Ohio.
**TRANSIENT RESPONSE OF FILTERS Interim Report, Oct. 1975 - Nov. 1977**
J. B. Y. Tsui, J. E. Adair, J. E. Hawkins, and S. J. LaFleur Dec. 1977 50 p
(AD-A055324; AFAL-TR-77-249) Avail: NTIS HC A03/MF A01 CSCL 09/5

One of the most important factors in designing receivers is to determine the transient response of the signal after it passes filters. It is time consuming and costly to measure the transient response experimentally. This report presents the theoretical analysis and a computer program to calculate filter transient response. Experimental data from both conventional and surface acoustic wave filters have also been presented to verify the validity of the program. The program can handle both Butterworth and Chebyshev filters and their combinations in cascade. The input signals can be a square, a composite, and a sine square wave. The computer program that calculates the transient response is also listed. Author (GRA)

**N78-31367#** IIT Research Inst., Chicago, Ill. Reliability Analysis Center.
**HYBRID MICROCIRCUIT FAILURE RATE PREDICTION Final Technical Report, Aug. 1976 - Feb. 1977**
Timothy E. Turner Apr. 1978 85 p refs
(Contract F30602-77-C-0167)
(AD-A055756; RADC-TR-78-97) Avail: NTIS HC A05/MF A01 CSCL 09/5

This report presents an updated reliability prediction model for hybrid microcircuits for inclusion in MIL-HDBK-217B, 'Reliability Prediction of Electronic Equipment'. The new model differs in several ways from the previous MIL-HDBK-217B prediction technique. Some of the changes include the addition of a density factor and an interconnection factor; changes in the package factor and quality factor; and individual assessments of the effect of temperature and environment on the elements of the hybrid microcircuits. Comparisons are presented comparing the predicted failure rates to the failure rate experienced by various hybrid microcircuits in the field. Also, the relative contributions of the terms in the model are compared to the distribution of field failure causes. Author (GRA)

**N78-31368#** Texas Instruments, Inc., Dallas.
**IC FABRICATION USING ELECTRON-BEAM TECHNOLOGY Quarterly Report, 1 Jun. - 1 Sep. 1977**
Gilbert L. Varnell, Ronald A. Williamson, Terry L. Brewer, John L. Bartelt, and Roger A. Robbins Nov. 1977 58 p
(Contract DAAB07-76-C-8105)
(AD-A055610; TI-03-77-46; QR-4) Avail: NTIS HC A04/MF A01 CSCL 09/5

The technical and economic impact of electron-beam direct slice printing will be demonstrated on 256 bit bipolar RAMs. All electron-beam tapes necessary for fabricating the 256 bit bipolar RAMs have been generated. Advanced software techniques such as geometry sizing, sorting and increment/decrement were used. E-beam processes have been developed for all lithographic steps on the 256 bit bipolar RAMs. Because of the pattern distortion at epitaxial growth, the original alignment marker system was modified. Several lots using this new alignment marker system are in process. The design of the Automatic Slice Loader is complete. Author (GRA)

**N78-31369#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**INVESTIGATION OF OPTIMAL LINEAR SHIFT-INVARIANT TWO-DIMENSIONAL DIGITAL FILTERS M.S. Thesis**
Richard B. Brown Dec. 1977 137 p refs
(AD-A055449; AFIT/GE/EE/77-10) Avail: NTIS HC A07/MF A01 CSCL 09/3

This investigation develops an interactive computer-aided method for designing lowpass or highpass two-dimensional finite impulse response digital filters. Filters designed using this method will have linear phase and an equiripple error in the transmission and attenuation bands. The essence of the method is that it transforms an optimal one-dimensional digital filter into a close approximation of an optimal two-dimensional digital filter. The amplitude characteristic of the one-dimensional filter is preserved in the sense that each point of the one-dimensional frequency response is mapped to a contour in the two-dimensional plane. This transformation was first proposed by James H. McClellan, and is now called McClellan Transformation. By controlling the mapping of a specified one-dimensional frequency to a desired contour shape in the plane, two-dimensional filters of fairly arbitrary specifications can be designed; that is, their frequency can be determined, and the associated two-dimensional impulse response coefficients calculated. Author (GRA)

**N78-31370#** Hughes Aircraft Co., Torrance, Calif. Electron Dynamics Div.
**LINEAR 1 kW MULTITONE TROPOSCATTER TWT Interim Report, 1 Sep. - 31 Dec. 1977**
A. L. Rousseau May 1978 33 p
(Contract DAAB07-77-C-2713; DA Proj. 1L7-62705-AH-94)
(AD-A055667; EDD-W-07564; ECOM-77-2713-1; IR-1) Avail: NTIS HC A03/MF A01 CSCL 09/1

This report covers the first triannual effort of a Research and Development program to design, construct, and test an advanced high efficiency traveling-wave tube designed to amplify multiple signals while minimizing and mixing products which result from non-linear operation. The tube will be operated in the linear region below saturation; tube efficiency will be enhanced by means of a four-stage depressed collector. The electron gun was scaled to the proper perveance and area convergence. Parts were ordered to check the scaled gun in the demountable beam analyzer. Preliminary thermal calculations have indicated that the tube can be air-cooled. The iron cavity walls, used in periodic permanent magnet focusing of the coupled cavity circuit, will be laminated with copper. A beam scraper section will also be incorporated for improved thermal dissipation. Parts and fixtures have been ordered to do the impedance matching of the RF interaction circuit. The mechanical design of the four-stage depressed collector has been started. Author (GRA)

**N78-31371#** California Univ., Livermore. Lawrence Livermore Lab.
**MARX BANK AND MAGNETRON CIRCUIT MODEL**
G. Craig and J. Pettibone Mar. 1978 14 p refs
(Contract W-7405-eng-48)
(UCID-17747) Avail: NTIS HC A02/MF A01

The exact solution to a circuit previously considered is presented. These results confirm the design parameters for the Marx Bank and provide a check for SCEPTER, the computer code which will be used on more realistic circuits to unravel the actual impedance characteristics of the magnetron. ERA

**N78-31372#** Massachusetts Inst. of Tech., Cambridge.
**CONTAMINATION FLASHOVER MECHANISMS OF dc TRANSMISSION LINE INSULATORS Final Report, 1 Sep. 1975 - 31 Aug. 1977**
Jan. 1978 352 p refs
(Contract EX-76-C-01-2068)
(HCP/T2068-1) Avail: NTIS HC A16/MF A01

A scaled contamination experiment modeling the electric field, air flow, and particle dynamics around an insulator string was implemented. Outstanding contamination features shown explicable by simple trajectory models include sharp clean rings and leeward wakes on the insulator surfaces, and diffuse contamination bands on the pin caps. Segregation of attracted and repelled particles to lower and upper regions of the string is observed. A practical contamination model in which surface deposition is proportional to normal electric field multiplied by particle mobility is shown to be quantitatively valid. Positive polarity contamination flashover occurred at 25% higher voltage than negative for a planar insulator. Possible theoretical reasons for this were tested experimentally. High speed photography showed arc growth rates of several hundred cm/sec. Computer modelling was done. Electrochemical effects were found to greatly influence the surface contaminant distribution, and hence the flashover voltage. ERA

**N78-31373#** Physics Lab. RVO-TNO, The Hague (Netherlands).
**A SURVEY OF PROPERTIES OF LATCHED NON-RECIPROCAL FERRITE PHASE SHIFTERS WITH CYLINDRICAL RODS AT 3, 5.5, 9.3, AND 16 GHz**
J. Snieder Aug. 1977 13 p ref Presented at the Intern. Conf. Radar-77, London, Oct. 1977 Submitted for publication
(PHL-1977-39; TDCK-69741) Avail: NTIS HC A02/MF A01

The examined ferromagnetic materials are magnesium-manganese ferrite, lithium ferrite, and mixed garnets. As a function of rod diameter, a survey is given of: the figure of merit, the differential phase shift per cm length and per cu cm, the waveguide width where the differential phase shift is independent of frequency, the peak power capability and the temperature dependance of the plus and minus remanent point, the differential phase shift and of the worst case of all phase shift settings.
Author (ESA)

**N78-31374#** AEG-Telefunken, Backnang (West Germany). Geschaeftsbereich Weitverkehr und Kabeltechnik.
**INSULATION TECHNIQUES IN HIGH VOLTAGE HIGH POWER CONVERTERS Final Report**
Paris ESA 1978 61 p refs
(Contract ESTEC-2317/74)
(ESA-CR(P)-1073) Avail: NTIS HC A04/MF A01

A new insulation technique was developed in view of the increased output voltage and the specific packaging and thermal requirement for high voltage converters used in high power applications (TV broadcasting, electric propulsion). The technical solution described is a power supply (EPC) for a 450 W TWT. The demonstration model performs well within the specifications (3.8 gr/W specific mass and 94% overall efficiency) and offers beyond optimization of weight and efficiency special simplicity of design. Because of its modular structure the unit may be easily repaired and - what appears to be much more important - may easily be adapted to varying load requirements. Both repair and adaption can be achieved by exchange of individual modules. Author (ESA)

**N78-31375#** Danish Research Center for Applied Electronics, Hoersholm.
**STUDY OF HYBRID POWER STRUCTURES Final Report**
E. Johansen and J. Kornum Paris ESA Apr. 1978 252 p
(Contract ESTEC-2928/76-NL-HP-(SC))
(ESA-CR(P)-1075) Avail: NTIS HC A12/MF A01

Hybrid power structures and high value capacitors were studied. Two actual output stages of a power system were considered: a linear power stage of 100 W and a switching power stage of 10 W for a boost regulator. The applied

manufacturing processes are described and the test results are discussed. The following tests were made: temperature distribution, step stress test, vibration, load life test, thermal shock, leak tests. ESA

**N78-31376#** European Space Research and Technology Center, Noordwijk (Netherlands). Product Assurance Div.
**EVALUATION AND QUALIFICATION OF THICK FILM HYBRID MICROCIRCUITS**
Paris ESA Nov. 1977 165 p
(ESA-Spec-QRC-06-Issue-2-Rev-1) Avail: NTIS HC A08/MF A01

The requirements for the evaluation and qualification of thick film hybrid microcircuits suitable for space application are presented. Topics include the evaluation phase; qualification test phase; maintenance, suspension and withdrawal of qualification; layout of test items. The evaluation phase comprises capability survey, line survey, evaluation testing, evaluation review, completion of the evaluation phase and validity of line certification. The requirements should be used in conjunction with specifications detailed in N78-23351. ESA

**N78-31377#** National Technical Information Service, Springfield, Va.
**INTEGRATED CIRCUIT RELIABILITY, VOLUME 3. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, Apr. 1976 - May 1978**
William E. Reed Jun. 1978 151 p Supersedes NTIS/PS-77/0486; NTIS/PS-76/0368; NTIS/PS-75/247
(NTIS/PS-78/0579/9; NTIS/PS-77/0486; NTIS/PS-76/0368; NTIS/PS-75/247) Avail: NTIS HC $28.00/MF $28.00 CSCL 09E

This updated bibliography contains 146 abstracts. Research pertinent to design, reliability prediction, failure and malfunction, processing techniques, and radiation damage is cited. GRA

**N78-31378#** National Bureau of Standards, Washington, D. C.
**EXPERIMENTAL DETERMINATIONS OF TEMPERATURES AND POWER LOSSES AT THE ELECTRICAL CONNECTIONS OF SOME DUPLEX RECEPTACLES Final Report**
G. W. Burns, M. G. Scroger, G. A. Evans, R. W. Beausoliel, and W. J. Meese Apr. 1978 66 p refs
(Contract HUD-IA-H-37-73)
(PB-280071/2; NBSIR-77-1380) Avail: NTIS HC A04/MF A01 CSCL 09A

The data presented compares the reliability of power loss determiniation with the reliability of temperature measurements as a means for determining the quality and adequacy of electrical connections on wiring devices used in branch circuit wiring. The basic premise for the tests presented is that in the laboratory the determination of power loss is easier, quicker, and not nearly as dependent on environmental factors as temperature. Research indicates that, if power at a specific current level does not exceed some set value(s), temperatures will not be excessive. This investigation also illustrates the overheating problems associated with copper-wire electrical connections. GRA

**N78-31379#** National Technical Information Service, Springfield, Va.
**MICROWAVE ELECTRIC POWER TRANSMISSION. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - May 1978**
William E. Reed Jun. 1978 56 p Supersedes NTIS/PS-77/0517; NTIS/PS-76/0445
(NTIS/PS-78/0580/7; NTIS/PS-77/0517; NTIS/PS-76/0445) Avail: NTIS HC $28.00/MF $28.00 CSCL 09C

The citations cover research on the transmission of electric power from one point to another using wireless free space radiated microwave beams. Some of the studies deal with the feasibility of these microwave transmission systems to transmit power from satellite solar power stations. GRA

**N78-31280#** Texas Instruments, Inc., Dallas.
**STATE-OF-THE-ART OF CCD AND SAW TECHNOLOGIES**
Lewis T. Claiborne *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 11 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31283#** Laboratoire Central de Recherches Thomson-CSF, Orsay (France).
**MICROWAVE SURFACE-ACOUSTIC-WAVE COMPONENTS**
P. Hartemann *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 9 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31284#** Microwave and Electronic Systems Ltd., Newbridge (Scotland).
**DEVELOPMENT OF A 100MHz BANDWIDTH PULSE COMPRESSION SUBSYSTEM FOR AIRBORNE APPLICATION**
M. B. N. Butler *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 10 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31286#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**INFLUENCE OF ACCELERATION ON SURFACE ACOUSTIC WAVE OSCILLATORS**
Michel Valdois, Patrick Levesque, and Pierre Hartemann (Laboratoire Central de Rech. Thomson-CSF, Orsay, France) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 6 p refs In FRENCH; ENGLISH summary (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31287#** Laboratoire Central de Recherches Thomson-CSF, Orsay (France).
**TUNABLE MAGNETOELASTIC SURFACE WAVE OSCILLATORS**
G. Volluet *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 11 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31288#** Allen Clark Research Centre, Towcester (England).
**PERFORMANCE LIMITATIONS OF TWO PHASE CCD'S**
V. A. Browne *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 8 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31289#** Edinburgh Univ. (Scotland). Dept. of Electrical Engineering.
**THE DESIGN AND DEVELOPMENT OF CCD PROGRAMMABLE TRANSVERSAL FILTERS AND CORRELATORS**
J. Mavor and P. B. Denyer *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 16 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31293#** AEG-Telefunken, Ulm (West Germany).
**DESIGN AND PERFORMANCE OF SAW-RESONATORS AND RESONATOR-FILTERS**
W. H. Haydl (Fraunhofer Gesellschaft, Freiburg), P. Hiesinger (Fraunhofer Gesellschaft, Freiburg), G. Kohlbacher, and P. Schmitt *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 7 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31294#** Rome Air Development Center, Hanscom AFB, Mass.
**SYSTEMS APPLICATIONS OF SAW FILTERS AND DELAY LINES**

Paul H. Carr *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 12 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31296#** Motorola, Inc., Scottsdale, Ariz.
**THE MONOLITHIC INTEGRATION OF SURFACE ACOUSTIC WAVE AND SEMICONDUCTOR CIRCUIT ELEMENTS ON SILICON FOR MATCHED FILTER DEVICE DEVELOPMENT**
Fred S. Hickernell and Henry J. Bush *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 13 p refs Prepared in cooperation with RADC, Griffiss AFB, N. Y. (For primary document see N78-31279 22-31)
(Contracts F30602-74-C-0021; F30602-76-C-0134)
Avail: NTIS HC A21/MF A01

**N78-31296#** Norges Tekniske Hoegskole, Trondheim. Dept. of Electrical Engineering.
**EXPERIMENTS AND ANALYSIS OF ACOUSTOELECTRIC MEMORY CORRELATORS**
K. A. Ingebrigtsen, A. Ronnekleiv, and S. Stueflotten *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 14 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31297#** Compagnie Generale de Telegraphie sans Fil, Paris (France). Div. des Activites Sous-Marines Chemin des Travails.
**CONVOLUTION AND CORRELATION MEMORY BY MEANS OF SURFACE ACOUSTIC WAVE DEVICES [CONVOLUTION ET CORRELATION A MEMOIRE A L'AIDE DE COMPOSANTS ACOUSTIQUES A ONDES DE SURFACE]**
H. Gautier, C. Maerfeld, and P. Tournois *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 14 p refs In FRENCH (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31299#** Allen Clark Research Centre, Towcester (England).
**CHARGE COUPLED DEVICES WITH SIMPLIFIED DRIVE REQUIREMENTS**
J. N. Gooding *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 7 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31301#** Societe Anonyme de Telecommunications, Paris (France).
**MODELIZATION OF METAL INSULATING SEMICONDUCTOR DEVICES ON CgHgTe APPLICATION TO A CHARGE TRANSFER DEVICE FOR INFRARED IMAGERY [MODELISATION DE STRUCTURES METAL-ISOLANT-SEMICONDUCTEUR SUR Cd Hg Te APPLICATION AUX DISPOSITIFS A TRANSFERT DE CHARGE POUR IMAGERIE INFRAROUGE]**
M. Sirieix, M. Garcia (Comm. a l'Energie Atomique, Grenoble), J. Farre (Lab. d'Automatique et d'Anal. des Systemes), and J. Simonne (Lab. d'Automatique et d'Anal. des Systemes) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 17 p refs In FRENCH (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31303#** Reticon Corp., Sunnyvale, Calif.
**CCPD: THE OPTIMUM SOLID-STATE LINE SCANNER**
Hsin-Fu Tseng and Gene P. Weckler *In* AGARD. Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 12 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31305#** Army Electronics Command, Fort Monmouth, N. J.
**APPLICATIONS OF A CHARGE COUPLED DEVICE SENSOR FOR NAP-OF-THE-EARTH HELICOPTER OPERATIONS**
A. Kleider *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 16 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31310#** Bell-Northern Research Ltd., Ottawa (Ontario).
**A HIGH PERFORMANCE CCD LINEAR IMAGING ARRAY**
A. A. Ibrahim, J. J. White, K. G. McQuhae, K. Y. Yu, D. Gallant, W. C. Bradley (Itek Corp., Lexington, Mass.), and D. W. Colvin (Itek Corp., Lexington, Mass.) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 10 p (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31311#** Microwave and Electronic Systems Ltd., Newbridge (Scotland).
**DEVELOPMENT AND APPLICATION OF A SAW CHIRP-Z TRANSFORMER**
M. B. N. Butler *In* AGARD Impact of Charge Coupled devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 10 p refs Sponsored in part by the Ministry of Defense (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31312#** Raytheon Co., Bedford, Mass. Missile Systems Div.
**THE CHIRP Z TRANSFORM WITH CCD AND SAW TECHNOLOGY**
D. MacFall, J. Collins, Sclarretta, and A. Cappon *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 13 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31313*#** Texas Instruments, Inc., Dallas.
**SPECTRAL ANALYSIS USING THE CCD CHIRP Z-TRANSFORM**
W. L. Eversole, D. J. Mayer, P. W. Bosshart, M. Dewit, C. R. Howes, and D. D. Buss *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 19 p refs (For primary document see N78-31279 22-31)
(Contract NAS1-14290; DAAB07-76-C-1386)
Avail: NTIS HC A21/MF A01

## 34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

**N78-31380*#** General Dynamics/Convair, San Diego, Calif.
**FILLING OF ORBITAL FLUID MANAGEMENT SYSTEMS**
F. Merino, M. H. Blatt, and N. C. Thies Jul. 1978 117 p refs
(Contract NAS3-21021)
(NASA-CR-159404; CASD-NAS-78-010) Avail: NTIS HC A06/MF A01 CSCL 20D

A study was performed with three objectives: (1) analyze fluid management system fill under orbital conditions; (2) determine what experimentation is needed; and (3) develop an experimental program. The fluid management system was a 1.06m (41.7 in) diameter pressure vessel with screen channel device. Analyses were conducted using liquid hydrogen and N2O4. The influence of helium and autogenous pressurization systems

was considered. Analyses showed that fluid management system fill will be more difficult with a cryogen than with an earth storable. The key to a successful fill with cryogens is in devising techniques for filling without vent liquid, and removing trapped vapor from the screen device at tank fill completion. This will be accomplished with prechill, fill, and vapor condensation processes. Refill will require a vent and purge process, to dilute the residual helium, prior to introducing liquid. Neither prechill, chill, nor purge processes will be required for earth storables. Author

**N78-31381*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**RADIATIVE AND GAS COOLING OF FALLING MOLTEN DROPS**
Michael B. Robinson Aug. 1978 37 p refs
(NASA-TM-78189) Avail: NTIS HC A03/MF A01 CSCL 20D

The supercooling rate and solidification time for molten drops of niobium, copper, and lead are calculated. Calculations for both radiation and helium gas cooling are presented in order to estimate the influence that the presence of helium gas would have upon the cooling rate of falling drops in the Marshall Space Flight Center space processing drop tube. G.Y.

**N78-31382*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**EVALUATION OF AAFE APPARATUS TO MEASURE RESIDUAL AND TRANSIENT CONVECTION IN ZERO-GRAVITY**
R. C. Ruff, B. R. Facemire, and W. K. Witherow Aug. 1978 36 p
(NASA-TM-78191) Avail: NTIS HC A03/MF A01 CSCL 20D

An evaluation apparatus which photographs convective and diffusive flows in crystal growth experiments is presented. Results in the following catagories are reported: (1) Human factors; (2) Electrical and mechanical; (3) Optical performance; and (4) Thermal performance. B.B.

**N78-31383*#** Stanford Univ., Calif. Thermosciences Div.
**LARGE EDDY SIMULATION OF INCOMPRESSIBLE TURBULENT CHANNEL FLOW**
P. Moin, W. C. Reynolds, and J. H. Ferziger May 1978 149 p refs
(Grant NGR-05-020-622)
(NASA-CR-157575; SU-TF-12) Avail: NTIS HC A07/MF A01 CSCL 20D

The three-dimensional, time-dependent primitive equations of motion were numerically integrated for the case of turbulent channel flow. A partially implicit numerical method was developed. An important feature of this scheme is that the equation of continuity is solved directly. The residual field motions were simulated through an eddy viscosity model, while the large-scale field was obtained directly from the solution of the governing equations. An important portion of the initial velocity field was obtained from the solution of the linearized Navier-Stokes equations. The pseudospectral method was used for numerical differentiation in the horizontal directions, and second-order finite-difference schemes were used in the direction normal to the walls. The large eddy simulation technique is capable of reproducing some of the important features of wall-bounded turbulent flows. The resolvable portions of the root-mean square wall pressure fluctuations, pressure velocity-gradient correlations, and velocity pressure-gradient correlations are documented. S.B.S.

**N78-31384*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DRAINING CHARACTERISTICS OF HEMISPHERICALLY BOTTOMED CYLINDERS IN A LOW-GRAVITY ENVIRONMENT**
Eugene P. Symons Aug. 1978 31 p refs
(NASA-TP-1297; E-9582) Avail: NTIS HC A03/MF A01 CSCL 20D

An experimental investigation was conducted to study the phenomenon of vapor ingestion during the draining of a scale model, hemispherically bottomed cylindrical tank in a low-gravity environment. Where possible, experimental results are compared with previously obtained numerical predictions. It was observed that certain combinations of Weber and Bond number resulted in draining-induced axisymmetric slosh motion. The periods of the slosh waves were correlated with the square root of the draining parameter, the ratio (Weber number)/(Bond number plus one), as was the quantity of liquid remaining in the tank when vapor was ingested into the outlet line. Author

**N78-31385#** Battelle Columbus Labs., Ohio.
**STUDY OF HEAT TRANSFER THROUGH REFRACTORY LINED GASIFIER VESSEL WALLS**
**Monthly Technical Progress Report, Jul. 1977**
J. Richard Schorr Aug. 1977 8 p
(Contract EX-76-C-01-2210)
(FE-2210-18) Avail: NTIS HC A02/MF A01

Heat transfer through refractory lined coal gasification vessel walls was evaluated. An empirically derived computer model suitable for determining the heat flow through complex, multicomponent refractory linings, such that the effect of lining thickness, density, composition, anchors, gases was developed. The program involves both the development of a heat flow computer model and the experimental measurement of heat flow in a test apparatus. ERA

**N78-31386#** Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
**INVESTIGATION OF TEST FACILITY EFFECTS ON THE THREE-DIMENSIONAL BOUNDARY LAYER INTERACTION**
**Final Report, Jan. - Apr. 1977**
Jerold L. Patterson Nov. 1977 63 p refs
(AF Proj. 1366)
(AD-A054237; AFFDL-TR-77-113) Avail: NTIS HC A04/MF A01 CSCL 20/4

A continuing uncertainty when correlating three-dimensional shockwave/turbulent boundary layer interaction data obtained from different wind tunnel facilities is the extent of 'facility-peculiar' effects on the test data, particularly the effect of free-stream Reynolds number. The present study investigates the pressure and heat transfer data in the interaction region taken at Mach 3 in three different facilities to determine the degree of dependency of the data on facility effects. The study shows that, for constant Mach number, the interaction data are essentially independent of facility effects or can be made independent through proper modification. The report also provides general data illustrating the physics of the interaction process for comparison with previous studies and to add to the general data base on three-dimensional interactions. Author (GRA)

**N78-31387#** Douglas Aircraft Co., Inc., Long Beach, Calif.
**BOUNDARY-LAYER AND INVERSE POTENTIAL-FLOW METHODS FOR AXISYMMETRIC BODIES**
**Final Technical Report, Jan. 1977 - Mar. 1978**
Tuncer Cebeci, Kalle Kaups, R. M. James, and D. P. Mack Mar. 1978 59 p refs
(Contract N00014-77-C-0087)
(AD-A054759; MDC-J7895) Avail: NTIS HC A04/MF A01 CSCL 20/4

This report provides a description of two methods and their computer programs for calculating viscous and inviscid flows past axisymmetric bodies. The first is a boundary-layer method for both laminar and turbulent flows. The procedure embodies a finite-difference representation of the boundary-layer equations and uses an eddy-viscosity model to represent turbulent flows. The second method is an inviscid-flow procedure which obtains solutions to the potential equation by an orthogonal expansion procedure. The accuracy is equivalent to higher-order Neumann solutions, but at a considerable savings of computer time. This method can be used in either a direct or an inverse mode. Details of each method are presented and the use of the computer program is documented with various test cases. Author (GRA)

**N78-31388#** Sybucon, Inc., Atlanta, Ga.
**VERIFICATION OF A THREE-DIMENSIONAL TURBULENT BOUNDARY-LAYER CALCULATION METHOD Final Technical Report, Aug. - Dec. 1977**
John F. Nash and Roy M. Scruggs Feb. 1978 58 p refs
(Contract F33615-77-C-3116)
(AD-A055606; AFFDL-TR-78-15) Avail: NTIS HC A04/MF A01 CSCL 20/4

The boundary-layer calculation method which forms the subject of this verification study, involves a radically different numerical scheme and geometry-handling scheme than has been employed in earlier methods. This turbulence model incorporates the empirically modified turbulent kinetic-energy equation together with an assumed relationship between the turbulent intensity and the Reynolds shear stress. The form of this relationship, and the forms of two other empirical functions of position through the boundary layer (the dissipation length and the diffusion function), have to satisfy certain rather broad theoretical constraints but otherwise must be adjusted, by trial and error, to give the best overall agreement with experiment. GRA

**N78-31389#** Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.

**PRELIMINARY EXPERIMENT DESIGNED TO SUPPORT A FEASIBILITY DEMONSTRATION OF A NOVEL METHOD FOR DEVELOPING UNSTEADY BOUNDARY LAYER PROFILES Interim Report, 1 Jan. - 31 Dec. 1977**

Eugene E. Covert and Alexander R. Kanevsky Apr. 1978 39 p refs

(Contract F49620-77-C-0031)

(AD-A055384; MIT-TR-202; AFOSR-78-0902TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

The feasibility of a new experimental technique for studying the effect of unsteady flows on boundary layers is under development. The method studied uses a stationary NACA 0012 airfoil in a steady subsonic wind tunnel. Unsteadiness in the flow over the airfoil would be generated by an unsteady external aerodynamic interference. Initial results are reported in which upwash effects of stationary cylinders of several sizes located at different positions downstream and below the airfoil are measured. The position for maximum influence is determined.Author (GRA)

**N78-31390#** Aerospace Corp., El Segundo, Calif. Ivan A. Getting Labs.

**TEMPERATURE CORRELATIONS IN TURBULENT BOUNDARY LAYERS Interim Report**

William C. Meecham 7 Jun. 1978 40 p refs

(Contract F04701-77-C-0078)

(AD-A055985; TR-0078(3606)-1) Avail: NTIS HC A03/MF A01 CSCL 20/4

Temperature fluctuation effects are examined in heated turbulent boundary layers. A modified Lagrangian integral procedure is used. The temperature fluctuations are matched at the laminar sublayer by using standard heat transfer theory to obtain their value. It is found that the temperature correlations are similar to the velocity correlations. They are, of course, at maximum near the laminar sublayer, decrease as one passes through that layer, and vanish beyond the boundary layer. The temperature correlation is an integral of the velocity correlations, which are assumed in this treatment to be given. It appears from this theory that they can have a small negative correlation at distances of a few local velocity scale lengths. There is a very weak Mach number dependence in the result.Author (GRA)

**N78-31391#** Pennsylvania State Univ., University Park. Applied Research Lab.

**SECONDARY FLOW VORTICITY IN THE PASSAGE OF A ROTOR**

M. L. Billet 17 Aug. 1977 28 p refs

(Contract N00017-73-C-1418)

(AD-A055388; TM-77-243) Avail: NTIS HC A03/MF A01 CSCL 20/4

Secondary flow theories are reviewed which can be employed to estimate the passage secondary vorticity near the inner wall of a rotor. Applications of these theories to a rotor operating within a boundary layer are discussed. For this case, the effect of blade rotation and changing relative velocity through the rotor on passage secondary vorticity become important. Author (GRA)

**N78-31392#** Naval Postgraduate School, Monterey, Calif.

**AN EXPERIMENTAL INVESTIGATION OF ENHANCED HEAT TRANSFER ON HORIZONTAL CONDENSER TUBES M.S. Thesis**

David J. Reilly Mar. 1978 217 p refs

(AD-A055430; NPS-69-78-011) Avail: NTIS HC A10/MF A01 CSCL 13/1

Heat transfer and hydrodynamic performance of three different spirally fluted tubes were determined. The tubes were 5/8-in. in nominal diameter and were made of aluminum. Results were compared to 5/8.in. OD, smooth copper-nickel and aluminum tubes. Data were taken by condensing steam at about 3 psia on the outside surface of a horizontally mounted tube in the center of a tube bank. The center tube was cooled by water on the inside at velocities of 3 to 25 feet per second. The overall heat transfer coefficient was determined directly from experimental data. The inside and outside heat transfer coefficients were determined using the Wilson plot technique. The cooling water pressure drop was measured inside the tube and converted to the friction factor in the enhanced section. The overall heat transfer coefficients of the enhanced tubes were as large as 1.75 times the corresponding smooth tube value for the same mass flow rate of cooling water. The inside heat transfer coefficients increased by about a factor of 3 while the outside heat transfer coefficients decreased by 10 to 20 percent when compared to smooth tube values. The results of this work indicate that the required condenser surface area can be reduced by 50 percent if these enhanced tubes are used in place of smooth tubes.

Author (GRA)

**N78-31393#** AiResearch Mfg. Co., Torrance, Calif.

**PRELIMINARY EVALUATION OF TUBULAR CERAMIC HEAT EXCHANGER MATERIALS Final Report**

D. L. Mann and K. H. Styhr 8 Dec. 1977 72 p refs

(Contract EX-76-C-01-2131)

(TID-28279) Avail: NTIS HC A04/MF A01

Promising new silicon carbide based materials were identified. Tests to obtain preliminary information on the applicability of these materials in stationary heat exchangers exposed to corrosion, high temperature environments were performed. Three types of alternate silicon carbide based materials were considered for evaluation: chemically vapor-deposited (CVD) silicon carbide (SIC); sintered silicon carbide; and composite carbon fiber reinforced, siliconized silicon carbide Si (SiC/C). The material specimens were subjected to nondestructive evaluation tests; a helium permeability measurement at 500 psi pressure at room temperature; a corrosion/erosion sequence consisting of rapid thermal cycling in 3000 F combustor gas followed by a coal slag deposition and coal slag meltoff test; and a determination of room temperature hoop tensile strength by internal pressurization to failure. ERA

**N78-31394#** Battelle Pacific Northwest Labs., Richland, Wash.

**THERMAL PERFORMANCE MEASUREMENTS ON ULTIMATE HEAT SINKS: COOLING PONDS**

R. K. Hadlock and O. D. Abbey Feb. 1978 105 p refs

(Contract EY-76-C-06-1830)

(NUREG/CR-0008; PNL-2463) Avail: NTIS HC A06/MF A01

Data were collected to characterize thermal performance of heat sinks for nuclear facilities existing at elevated water temperatures in result of experiencing a genuinely large heat load and responding to meteorological influence. The data reflect thermal performance for combinations leading to Worst-case meteorological influence. A geothermal water retention basin was chosen as the site for the measurement program. The data illustrate the thermal and water budgets during episodes of cooling from an initially high pond water bulk temperature. Monitoring proceeded while the pond experienced only meteorological and seepage influence. The data are discussed and are presented as a data volume which may be used for calculation purposes. ERA

**N78-31395#** Delft Hydraulics Lab. (Netherlands). Working Group on Small Hydraulic Structures.

**DISCHARGE MEASUREMENT STRUCTURES**

M. G. Bos, ed. May 1976 478 p refs Prepared jointly with the Intern. Inst. for Land Reclamation and Improvement and the Agr. Univ. Wageningen

(Publ-161) Avail: NTIS HC A21/MF A01

Instructions, standards and procedures for the selection, design and use of structures which measure or regulate the flow rate in open channels are presented. Topics include basic principles of fluid flow as applied to measuring structures; auxiliary equipment; the selection of structures; broad-crested weirs; sharp-crested weirs; short-crested weirs; flumes; orifices. Discussion on basic equations of motion in fluid mechanics; the

overall accuracy of flow measurement; side weirs and oblique weirs; suitable stilling basins are annexed. ESA

**N78-31396#** Delft Hydraulics Lab. (Netherlands).
**FLOW-INDUCED GATE VIBRATIONS: PREVENTION OF SELF-EXCITATION. COMPUTATION OF DYNAMIC GATE BEHAVIOUR AND THE USE OF MODELS Ph.D. Thesis - Delft Univ. of Technol.**
P. A. Kolkman Jul. 1976 241 p refs
(Publ-164) Avail: NTIS HC A11/MF A01

Design criterions for the dynamic behavior of gates and valves were developed. An extended analysis of the added water mass, hydrodynamic rigidity, damping (also negative damping or self-excitation) and excitation by turbulent flow, was made. New computation methods are presented for self-exciting vibrations: the ensuing introduction of an instability indicator permits the prediction of such vibrations in the design phase. Methods are described to calculate the added water mass and water damping in flow water. Also treated are the instability of overflowing and falling water curtains, the response of a mass-spring system to noise excitation by turbulence, and the technique of hydroelastic models. Author (ESA)

**N78-31397#** Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.
**INVESTIGATION ON THE INFLUENCE OF A HYDRODYNAMIC PRECURSOR STAGE ON THE HEAT TRANSFER AT A FLAT CHANNEL WALL [UNTERSUCHNGEN ZUM EINFLUSS EINES HYDRODYNAMISCHEN VORLAUFS AUF DEN WAERMEUEBERGANG AN EBENE KANALWAENDE]**
Christoph Haberland and Wolfgang Nitsche 1977 49 p refs In GERMAN Sponsored by Deut. Forschungsgemeinschaft
(ILR-22; ISBN-3-7983-0591-9) Avail: NTIS HC A03/MF A01

Theoretical and experimental investigations were made on the heat transfer at the wall of a short rectangular channel as a function of serial inlet configurations (contraction, hydrodynamic precursor stage). The experimental results can be described by a simple approximation method based on separate treatment of the temperature and the flow fields analogous to the Reynolds method. The approximation method produces the heat transfer for any hydrodynamic precursor stage length from the ratio between the Nusselt number of a thermal inlet behind an unheated precursor stage and the Nusselt number for a simultaneous thermal and hydrodynamic inlet process. ESA

**N78-31398#** National Aerospace Lab., Amsterdam (Netherlands). Scientific Services.
**A SIMPLE FINITE-DIFFERENCE TECHNIQUE FOR THE COMPUTATION OF THREE-DIMENSIONAL INCOMPRESSIBLE LAMINAR BOUNDARY LAYERS. PART 2: DESCRIPTION OF THE PROGRAM**
J. P. F. Lindhout and E. deBoer Jan. 1978 46 p refs
(Contract NIVR-1737)
(NLR-TR-76086-U-PT-2) Avail: NTIS HC A03/MF A01

An ALGOL-60 program for the solution of the 3D laminar boundary layer problem over developable surfaces by means of a finite-difference scheme is described in detail. A program listing and an example of input and output can be obtained on microfiche. Author (ESA)

**N78-31399#** Dornier-System G.m.b.H., Friedrichshafen (West Germany).
**DESIGN AND DEVELOPMENT OF A GAS CONTROLLED HEAT PIPE RADIATOR FOR COMMUNICATION SPACECRAFT APPLICATION. LIFE TEST REPORT**
Paris ESA May 1978 15 p
(Contract ESTEC-2268/74)
(ESA-CR(P)-1082) Avail: NTIS HC A02/MF A01

Two heat pipes P1 and P2 were life tested over a period of about three years: P1 (axial grooved ammonia heat pipe; profile type DS-WR4); P2 (same type heat pipe with a coupled gas reservoir; N2 as the inert gas). The life test conditions did not change during the test period of the 3 years. Each 6 months the life test was stopped for a periodical performance test. The latest performance tests were carried out after a test period of 36 months. During life test, each heat pipe was loaded with about 25 Watt heat input and was cooled by radiation and convection to the surrounding atmosphere. Both pipes were arranged in a horizontal position, the operation temperature was around 50 C. No gas generation or performance degradation was noticed in the test period. Author (ESA)

**N78-31400#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Raumsimulation.
**PRESSURE DISTRIBUTION IN AN OPEN CAVITY AT LINEAR INCREASING EXTERNAL PRESSURE**
Hans Hamacher 7 Dec. 1977 37 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-510)
(DLR-FB-77-53) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 19,40

A method is described for calculating the pressure profile in a cavity, connected by an opening with an environment in which the pressure is increasing linearly. The following conditions were assumed: constant volume, no gas sources inside the cavity, the same gases inside and outside the cavity and equal pressures at the start. Calculations were performed for both the adiabatic and isothermal changes of state, taking into account in first approximation the gas friction inside the opening. The solutions depend on two parameters. All necessary functions are given in the form of diagrams. The measured pressure functions obtained for an approximately 3 liter vessel are compared with theoretical results. Author (ESA)

**N78-31401#** Advisory Group for Aerospace Research and Development, Paris (France).
**INSTABILITY, TRANSITION TO TURBULENCE AND PREDICTABILITY**
M. V. Morkovin (Illinois Inst. of Technol., Chicago) Jul. 1978 38 p refs Presented at AGARD Fluid Dyn. Panel Symp. on Laminar-Turbulent Transition, Lyngby, Den., 2-4 May 1977
(AGARD-AG-236; ISBN-92-835-1288-X) Avail: NTIS HC A03/MF A01

A concise state of the art review on the phenomenon of transition which constituted the opening address at the Fluid Dynamics Panel Symposium on Laminar-Turbulent Transition (AGARD-CP-224) held in Lyngby, Denmark, 2-4 May 1977 is presented. Various instability mechanisms leading to transition are proposed and discussed. A variable insight is provided based on existing experimental evidence and postulated flow structures. Critical questions are asked relating to the conceptual foundation on which much of the transition effort is based. To enhance understanding of the basic mechanisms and processes, detailed microscopic experiments are encouraged to increase the data base. G.Y.

# 35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

**N78-31402** Connecticut Univ., Storrs.
**TWO-CRYSTAL SOFT X-RAY SPECTROMETER Ph.D. Thesis**
Thomas Krainer Gregory 1978 102 p
Avail: Univ. Microfilms Order No. 78-13851

The design and implementation of a new two-crystal vacuum X-ray spectrometer is described in detail. The primary design goals of the instrument are optimum time usage, maximum instrument flexibility, and precise angular positioning. The design of an automated instrument to achieve these goals is discussed, followed by a detail description of the design implementation. X-ray generation and detection systems to be used with the instrument for X-ray absorption-edge spectroscopy are outlined. A procedure for the alignment of the instrument is discussed and performance results are presented. Finally, a measurement

of the K-edge absorption spectrum of nickel is presented, along with comparisons to theory and previous experimental data.
Dissert. Abstr.

**N78-31403*#** California Inst. of Tech., Pasadena. Seismological Lab.
**STREAK CAMERA TIME CALIBRATION PROCEDURES**
James Long and Ian Jackson 1978 14 p ref
(Grants NsG-9019; NGL-05-002-105)
(NASA-CR-157573) Avail: NTIS HC A02/MF A01 CSCL 14E

Time calibration procedures for streak cameras utilizing a modulated laser beam are described. The time calibration determines a writing rate accuracy of 0.15% with a rotating mirror camera and 0.3% with an image converter camera.
Author

**N78-31404*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**MEASUREMENT TECHNIQUES AND APPLICATIONS OF CHARGE TRANSFER TO AEROSPACE RESEARCH**
Alphonsa Smith Sep. 1978 21 p refs
(NASA-TM-78734; L-12278) Avail: NTIS HC A02/MF A01 CSCL 14B

A technique of developing high-velocity low-intensity neutral gas beams for use in aerospace research problems is described. This technique involves ionization of gaseous species with a mass spectrometer and focusing the resulting primary ion beam into a collision chamber containing a static gas at a known pressure and temperature. Equations are given to show how charge-transfer cross sections are obtained from a total-current measurement technique. Important parameters are defined for the charge-transfer process.
Author

**N78-31405*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**INSTRUMENTS FOR MEASURING THE AMOUNT OF MOISTURE IN THE AIR**
Dale L. Johnson Aug. 1978 48 p refs
(NASA-TM-78190) Avail: NTIS HC A03/MF A01 CSCL 14B

A summarization and discussion of the many systems available for measuring moisture in the atmosphere is presented. Conventional methods used in the field of meteorology and methods used in the laboratory are discussed. Performance accuracies, and response of the instruments were reviewed as well as the advantages and disadvantages of each. Methods of measuring humidity aloft by instrumentation onboard aircraft and balloons are given, in addition to the methods used to measure moisture at the Earth's surface.
B.B.

**N78-31406*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**DISPLACEMENT PROBES WITH SELF-CONTAINED EXCITING MEDIUM Patent Application**
Robert Miserentino and Bruce Flagge, inventors (to NASA) Filed 26 Jul. 1978 10 p
(NASA-Case-LAR-11690-1; US-Patent-Appl-SN-928129) Avail: NTIS HC A02/MF A01 CSCL 14B

A device for measuring the displacement of a vibrating surface is presented. This device is especially useful in determining the displacement of a vibrating nonhomogeneous surface. The novel feature of the invention is the inclusion of a self-contained target with a noncontacting probe. This facilitates measurements of nonhomogeneous surfaces to which it is difficult or impossible to attach fixed targets.
NASA

**N78-31407#** Army Engineer Topographic Labs., Fort Belvoir, Va.
**REVIEW OF PHOTOSENSITIVE MATERIALS FOR HOLOGRAPHIC RECORDINGS**
James W. Gladden Apr. 1978 85 p refs
(DA Proj. 4A1-61102-B-52C)
(AD-A055013; ETL-0128) Avail: NTIS HC A05/MF A01 CSCL 14/5

There is a program objective to systematically evaluate photosensitive recording materials that can be used in holographic and other coherent optical systems. In association with this, a detailed literature search was undertaken in which considerable information was obtained and compiled in this report. An objective of this report is to describe aspects of the recording materials in a way that will aid in their future development and use in holography. Over 100 references were reviewed that treat electrostatic imaging materials, photoresists, hardened dichromated gelatin, photopolymers, photochromic materials, and bleached silver halide materials. Subcategories include Scott Graphics TEP film; photoplastic film; diazos, diazo-oxides and azides; Shipley:s AZ 1350 positive photoresists; Hughes-NRC, DuPont and Bell Laboratories photopolymers; photochromic lithium niobate; and different halide bleaches for silver halide bleached holograms. The report compares a number of the characteristics of the different classes of holographic recording materials.
GRA

**N78-31408#** Illinois Inst. of Tech., Chicago.
**ON TEMPERATURE AND YAW DEPENDENCE OF HOT-WIRES**
R. E. Drubka, H. M. Nagib, and J. Tan-Atichat Aug. 1977 267 p refs
(Contract F44620-76-C-0062; Grants DAHC04-74-G-0160; NSF ENG-76-04112)
(AD-A055937; IIT-Fluids/Heat-Trans-R77-1; ARO-12290.9-E) Avail: NTIS HC A12/MF A01 CSCL 14/2

A scheme utilizing a temperature probe immersed in the working fluid to compensate for the dependence of hot-wire velocity calibration on ambient temperature variations was analyzed. One needs only to know the properties of the anemometer bridge and the velocity and temperature probes to achieve the compensation. Hence the scheme provides means for incorporating the temperature compensation a priori to conducting the experiments without any need for temperature calibration.
GRA

**N78-31409#** Minnesota Univ., Minneapolis. Dept. of Chemistry.
**DIGITAL SPECTROMETER SCAN CONTROLLER**
L. R. Wilson and D. B. Johnston 1977 15 p
(Contract EY-76-S-02-0913)
(COO-913-67) Avail: NTIS HC A02/MF A01

An electronic device for control of a stepping motor scanned spectrometer is described. The device digitally displays wavelength, stops a scan at a preset wavelength and remotely controls a strip chart recorder. The primary utility of the device is in obtaining precise wavelength reproducibility in recorded spectra.
ERA

**N78-31410#** Kanner (Leo) Associates, Redwood City, Calif.
**REAL TIME DIGITAL SAMPLER**
1978 23 p Transl. into ENGLISH of "Echantilconneur Digital en Temps Reel", Rept. DAM/DT/DEV/-ANL-131/72 LEA, Direc. des Appl. Militaires, Direc. Tech., Dept. Develop. Serv. Electronique Antenne Cesta, Saclay, France, 12 Apr. 1972 Prepared for Los Alamos Sci. Lab., N. Mex.
(Contract W-7405-eng-36)
(LA-TR-78-23; DAM/DT/DEV/ANL-131/72) Avail: NTIS HC A02/MF A01

Systems of fine chronometry were designed which play the role of vernier for devices counting clock pulses at a frequency of 100 MHz or higher. In this way, chronometers and multichronometers with resolution of 1 ns or 100 ps were able to be made or are in progress at DAM/DT/DEV/ AnL. It is shown how going from the systems of fine chronometry to low dead time, it is possible to conceive real time samplers. Topics include: (1)the principle and functioning of chronometers for fragments of a line at one, two or n levels; (2)the principle of the real time samplers in amplitude-time conversion; (3)analysis of the head of the amplitude-time conversion; (4)presentation and characteristics of two versions of the 'real time samplers', and (5)eventual improvements.
ERA

**N78-31411#** Addis Translations International, Portola Valley, Calif.
**CERTAIN CHARACTERISTICS OF THE STABILIZATION SYSTEM OF A GAMMA-RAY SPECTROMETER WITH A LIGHT-EMITTING DIODE AS THE SOURCE OF THE REFERENCE SIGNAL**
V. V. Bakhterev, A. V. Bausov, L. A. Zyryanov, I. N. Senko-Rulatnyi, and A. V. Shindelman Feb. 1978 9 p refs Transl. into

ENGLISH from the book "Yaderno-Geofizicheskie Issledovaniya" USSR, 1975 p 58-63 Sponsored by DoE Prepared for Lawrence Livermore Lab., Livermore, Calif.
(UCRL-Trans-11330) Avail: NTIS HC A02/MF A01

A downhole gamma-ray spectrometer with reference stabilization has been designed at the institute of geophysics of the Ural Science Center of the USSR Acsdemy of Sciences. Some results of the experimental operation of the instrument are presented. ERA

**N78-31306#** Plessey Radar Ltd., Havant (England).
**A CCD DIGITAL IMAGE STORE**
D. M. Balston and P. R. Samways *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 9 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31999*#** Naval Research Lab., Washington, D. C.
**GAMMA RAY SPECTROSCOPY IN ASTROPHYSICS: FUTURE ROLE OF SCINTILLATION DETECTORS**
J. D. Kurfess *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 438-449 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 14B

**N78-32000*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**CAPABILITIES OF GERMANIUM DETECTORS**
J. B. Willett, J. C. Ling, W. A. Mahoney, and A. S. Jacobson *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 450-461 ref (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 14B

**N78-32003*#** National Aeronautics and Space Administration, Washington, D. C.
**THE NUCLEAR RADIATION MONITOR FOR THE SPACE-LAB/SHUTTLE**
G. J. Fishman *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 479-483 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 14B

## 36 LASERS AND MASERS

Includes parametric amplifiers.

**N78-31412*#** Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
**A LASER SCANNER FOR 35mm FILM. Final Report, 25 Feb. 1975 - 24 Apr. 1977**
W. R. Callen and J. E. Weaver Apr. 1977 39 p refs
(Contract NAS8-31193; Proj. E-21-657)
(NASA-CR-150810) Avail: NTIS HC A03/MF A01 CSCL 20E

The design, construction, and testing of a laser scanning system is described. The scanner was designed to deliver a scanned beam over a 2.54 cm by 2.54 cm or a 5.08 cm by 5.08 cm format. In order to achieve a scan resolution and rate comparable to that of standard television, an acousto-optic deflector was used for one axis of the scan, and a light deflecting galvanometer for deflection along the other axis. The acoustic optic deflector has the capability of random access scan controlled by a digital computer. G.G.

**N78-31413*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**A COMPARATIVE STUDY OF OPTIMUM AND SUBOPTIMUM DIRECT-DETECTION LASER RANGING RECEIVERS**
James B. Abshire Sep. 1978 43 p refs
(NASA-TP-1315; G-7802-F15) Avail: NTIS HC A03/MF A01 CSCL 20E

A summary of previously proposed receiver strategies for direct-detection laser ranging receivers is presented. Computer simulations are used to compare performance of candidate implementation strategies in the 1- to 100-photoelectron region. Under the condition of no background radiation, the maximum-likelihood and minimum mean-square error estimators were found to give the same performance for both bell-shaped and rectangular optical-pulse shapes. For signal energies greater than 100 photoelectrons, the root-mean-square range error is shown to decrease as Q to the -1/2 power for bell-shaped pulses and Q to the -1 power for rectangular pulses, where Q represents the average pulse energy. Of several receiver implementations presented, the matched-filter peak detector was found to be preferable. A similar configuration, using a constant-fraction discriminator, exhibited a signal-level dependent time bias. Author

**N78-31414#** Army Missile Research and Development Command, Redstone Arsenal, Ala. High Energy Laser and Research Lab.
**COMPILATION OF DATA RELEVANT TO RARE GAS-RARE GAS AND RARE GAS-MONOHALIDE EXCIMER LASERS, VOLUME 1**
E. W. McDaniel, M. R. Flannery, H. W. Ellis, F. L. Eiselle, and W. Pope Dec. 1977 429 p refs
(AD-A053827; DRDMI-H-78-1-Vol-1) Avail: NTIS HC A19/MF A01 CSCL 20/5

This report is a compilation of atomic data designed mainly to serve the needs of those engaged in research and development in the field of rare gas-halide and rare gas-rare gas excimer lasers. The bulk of the data relates to structural, radiative, and collisional properties of rare gas and halogen atoms and of the ions and molecules that can be formed from them. Two- and three-body collisions involving only heavy particles are covered, as are collisions of electrons and photons with the heavy particles. Author (GRA)

**N78-31415#** New Mexico State Univ., Las Cruces. Engineering Experiment Station.
**THE DEVELOPMENT AND APPLICATION OF NEW EXPERIMENTAL LABORATORY TECHNIQUES AND EQUIPMENT FOR MEASURING LASER ENERGY ATTENUATION IN THE ATMOSPHERE Final Report**
Stuart A. Schleusener 5 May 1976 44 p refs
(Contract DAAD07-75-C-0070; DA Proj. 1T1-61102-B-53A)
(AD-A055082) Avail: NTIS HC A03/MF A01 CSCL 20/6

An open walled White-cell system was constructed and tested for application to particulate attenuation measurements. Particle sizing and generating apparatus were included in the system as was a minicomputer based data acquisition system. Spectrophones were developed to measure atmospheric dust absorption using the KBr pellet method of sample handling. Results of these efforts were presented in one presentation and two open literature articles, reprints of which are included in this report. Author (GRA)

**N78-31416#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**OUTPUT POWER VARIATIONS IN Nd:YAG LASER HOSTS M.S. Thesis**
Warren B. Maupin, II Dec. 1976 60 p refs
(AD-A055180; AFIT/GEP/PH/76-8) Avail: NTIS HC A04/MF A01 CSCL 20/5

Seemingly identical Nd:YAG laser rods often exhibit significant variations in output power. The purpose of this report is to investigate the possible cause or causes for the performance variations in Nd:YAG laser rods. The fundamental chemical and crystal growth characteristics of Nd:YAG are reviewed. The spectroscopy of Nd:YAG is discussed with emphasis on the laser transition. The more common spectroscopic parameters are defined and the important relationships between them derived. Expressions relating the laser performance of CW and Q-switched systems to the host parameters are developed and the important parameters are discussed. Possible energy transfer mechanisms to account for performance variations are presented and evaluated. It is proposed that concentration variations are primarily responsible for laser performance fluctuations and a method for obtaining experimental verification is outlined. Author (GRA)

**N78-31417#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**THE LASER LIGHTNING ROD SYSTEM: A FEASIBILITY STUDY M.S. Thesis**

Charles W. Schubert, Jr. Dec. 1977 142 p refs
(AD-A055255; AFIT/GEP/PH/77-11) Avail: NTIS HC A07/MF A01 CSCL 20/5

The feasibility of triggering lightning with an intense laser pulse is investigated. Physical mechanisms by which such triggerings might occur are examined, and criteria for lightning initiation with a laser beam established. A differential equation for determining the free electron distribution along a kilometer-long laser beam is developed, based on the electron-cascade model of gas breakdown. Predictions are made of the electron distribution along laser beams of various focal lengths, wavelengths, pulse shapes, pulse lengths, and flux intensities. The predicted densities are compared with the criteria for triggering lightning. A conclusion is drawn that the triggering of lightning with a laser pulse is feasible from the standpoint of the physics involved; but would require large laser apertures, short pulse lengths, and flux intensities at the aperture near the threshold for the breakdown of air. Author (GRA)

**N78-31418#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**ABSORPTANCE OF IR LASER RADIATION AT A METALLIC INTERFACE AT VARIOUS ANGLES OF INCIDENCE AND POLARIZATIONS M.S. Thesis**

Richard Allen Henson Dec. 1977 65 p refs
(AD-A055256; AFIT/GEP/PH/77-5) Avail: NTIS HC A04/MF A01 CSCL 11/6

A calorimetric method is developed to measure the absorptance of IR laser radiation at a metallic interface. The absorptance of Al and Ti is measured at various angles of incidence (10 to 87 deg) and laser polarizations (parallel, perpendicular, and random relative to the plane of incidence). Designing the metal surface to be approximately the size of the beam and using a thin (0.032 in.) sample facilitate the simplifying assumptions. The average incident power is 13 w/sq.cm. For the laser polarizations, parallel and perpendicular, the maximum difference between theoretically and experimentally calculated values is 26 percent and 57 percent respectively for Al and 100 percent and 500 percent respectively for Ti. The Ti values are largely attributed to surface roughness (sanded) and oxidation. Without a Brewster window in the laser cavity, a test revealed the laser polarization was not 50 percent horizontal and 50 percent vertical. The average polarization is 17 percent horizontal and 83 percent vertical. Author (GRA)

**N78-31419#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**REACTION-R CONSTANTS AND SIMPLE RATE THEORIES APPLIED TO THE MERCURY-CHLORIDE LASER M.S. Thesis**

Robert P. Summers Mar. 1978 119 p refs
(AD-A055229; AFIT/GNE/PH/78M-9) Avail: NTIS HC A06/MF A01 CSCL 20/5

Several simple theories for reaction-rate constants are applied to the HgCl laser reactions. These theories are discussed and analyzed using existing data. The theories that are discussed are applicable to dissociative recombination, dissociative attachment, ion neutral association, bimolecular charge transfer, ionic recombination, and harpooning reactions. A simple theoretical model of the HgCl laser is constructed. The gases that are included in the laser are Ar, Xe, Hg, and Cl2. Reaction-rate constants for the reactions are computed using either theoretical or experimental data. The model is analyzed using an analytical approach and a computer generated solution. The model is found to be very sensitive to the dissociative attachment rate of Cl2 and electron impact pumping rate constants. This report contains an 82-item bibliography. Author (GRA)

**N78-31420#** California Inst. of Tech., Pasadena.

**COMBUSTION DYNAMIC PROCESSES ASSOCIATED WITH CHEMICAL ADVANCED LASING SYSTEMS Final Report, 1 Apr. 1974 - 31 Mar. 1978**

F. E. C. Culick May 1978 21 p refs
(Grant AF-AFOSR-2694-74)
(AD-A055659; AFOSR-78-1061TR) Avail: NTIS HC A02/MF A01 CSCL 20/5

A four-year program has been devoted to some problems of combustion dynamics arising in chemical lasers. The subjects treated are common to any system to be used as the basis for a laser, but the CS2/O2 system has been adopted as the particular example. This work has been generally concerned with the combined influences of molecular kinetics, chemical kinetics and fluid mechanics. Both experimental and analytical efforts have been directed to pre-mixed flames and the reacting laminar mixing layer, all at low speeds (- 10 m/sec) and low pressures (- 20 torr). Data for the flame speeds of pre-mixed flames have been used to verify the simplified kinetics mechanism deduced early in this program. Observations of spontaneous emission have been used to deduce flow temperatures; and the populations and rates of populations for the vibrational levels of carbon monoxide produced in the reactions O + CS yields CO + S. Those results, taken over broad ranges of mixtures and flow conditions, and combined with analytical work, have shown why, for this system, combustion in the laminar mixing layer is greatly inferior to pre-mixed flames for producing stimulated emission. Author (GRA)

**N78-31421#** California Univ., Livermore. Lawrence Livermore Lab.

**INJECTION LOCKED, UNSTABLE RESONATOR KrF DISCHARGE LASER WITH LINEWIDTH OF 3 GHz**

J. R. Murray and J. Goldhar Dec. 1977 4 p ref Presented at the 10th Intern. Quantum Electronics Conf., Atlanta, 29 May 1978 - 1 Jun. 1978
(Contract W-7405-eng-48)
(UCRL-80495; Conf-780510-3) Avail: NTIS HC A02/MF A01

The full 100 mJ output of a KrF TEA laser was extracted in a mode of high spatial quality and with a linewidth as low as GHz. The effects of mode mismatch between the oscillator and regenerative amplifier are discussed. Data are presented to show the influence of such mode mismatching and of discharge energy loading in the amplifier on the far field intensity distribution of the laser. ERA

**N78-31422#** California Univ., Livermore. Lawrence Livermore Lab.

**FORBIDDEN TRANSITION SELENIUM ATOM PHOTODISSOCIATION LASERS**

H. T. Powell and J. J. Ewing Dec. 1977 5 p refs Presented at the 10th Intern. Quantum Electronics Conf., Atlanta, 29 May 1978 - 1 Jun. 1978
(Contract W-7405-eng-48)
(UCRL-80490; Conf-780510-4) Avail: NTIS HC A02/MF A01

Weak laser oscillation was demonstrated on the 489 and 777 nm electric dipole forbidden 1S0-1P1 and 1S0-1D2 transitions of the selenium atom. Carbonyl selenide was photolyzed at 172 nm by Xe2 radiation to produce the Se(1S0)excited state. ERA

**N78-31423#** Vanderbilt Univ., Nashville, Tenn.

**SPECTROSCOPIC STUDIES OF ULTRAVIOLET LASING TRANSITIONS IN DIATOMIC MOLECULES Final Report, 1 Nov. 1975**

Joel B. Tellinghuisen 1977 23 p refs
(Contract EY-76-S-05-5005)
(ORO-5005-16) Avail: NTIS HC A02/MF A01

Lasing was achieved for XeBr(2820A), XeCl(3080A), XeF(3510 and 3530 A), KrCl(2220 A), KrF(2490 A), ArCl(1750 A), and ArF(1930 A). In similar experiments, lasing was also reported for UV transitions in I2(3420 A), Br2(2920 A), and F2(1580 A). Dozens of papers were published on these new lasers and the rare gas fluoride lasers are now available commerically. The AF lasers were made to operate with moderate efficiency (1 to 3 percent) and high pulse power (10 to the 9th power W), hence are of possible practical import in laser isotope separation schemes and military applications. ERA

**N78-31424#** National Technical Information Service, Springfield, Va.

**RADIATION DAMAGE OF LASER MATERIALS. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - May 1978**

Mona F. Smith Jun. 1978 236 p Supersedes NTIS/PS-77/

0435; NTIS/PS-76/0383; NTIS/PS-75/399; COM-73-11713 (NTIS/PS-78/0516/1; NTIS/PS-77/0435; NTIS/PS-76/0383; NTIS/PS-75/399; COM-73-11713) Avail: NTIS HC $28.00/MF $28.00 CSCL 20E

Laser beam damage to laser materials such as optical glass, glass fibers, alkali metal halides, metals, mirrors, optical coatings, dielectrics, semiconductors, and matrix materials is studied. The majority of these citations concern infrared laser damage to infrared optical materials. GRA

# 37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

**N78-31425** Michigan Univ., Ann Arbor.
**THE INFLUENCE OF OVERALL FUEL-AIR RATIO AND DEGREE OF STRATIFICATION ON THE FUEL CONSUMPTION AND EMISSIONS OF A PRECHAMBER, STRATIFIED-CHARGE ENGINE Ph.D. Thesis**
James Fern Sinnamon 1978 197 p
Avail: Univ. Microfilms Order No. 781376

The engine was operated with a homogeneous fuel-air charge at a given fuel-air ratio. The prechamber was progressively enriched while the main chamber was leaned to maintain constant overall fuel-air ratio.. This procedure was repeated for values of overall fuel-air ratios from stoichiometric down to the lean limit of operation while power, emissions, and fuel consumption were measured. The effects of flow ratio were studied by varying flow ratio from 2% to 10% at constant overall fuel-air ratio. Results include: (1) analysis of flame photographs and combustion pressure records shows that stratified charge combustion is characterized by a shorter combustion interval and a higher peak pressure due to a more rapid initial mass burning rate; (2) emissions were strongly dependent upon both degree of stratification and overall fuel-air ratio; and (3) highly stratified engine operation produced large CO emissions even at lean overall fuel-air ratios. Dissert. Abstr.

**N78-31426*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ACTUATOR MECHANISM Patent**
William C. Stange, inventor (to NASA) Issued 6 Jun. 1978 10 p Filed 6 Dec. 1976 Supersedes N77-15400 (15 - 06, p 0757) Continuation-in-part of US Patent Appl. SN-596787, filed 17 Jul. 1975, US-Patent-4,010,455
(NASA-Case-GSC-11883-2; US-Patent-4,092,874; US-Patent-Appl-SN-747675; US-Patent-Class-74-100R; US-Patent-Class-60-527; US-Patent-4,010,455; US-Patent-Appl-SN-596787) Avail: US Patent Office CSCL 13I

An actuator mechanism is described, having a frame with a rotatable shaft supported in the frame, a positioning mechanism coupled to the shaft for rotating the shaft in two rotary positions, disposed approximately 180 degrees apart, and a pair of plungers coupled to the shaft. Each plunger is responsive to a control signal for applying bi-directional rotation to the shaft.
Official Gazette of the U.S. Patent Office

**N78-31427*#** General Electric Co., Cincinnati, Ohio.
**ROLLING ELEMENT FATIGUE TESTING OF GEAR MATERIALS**
A. H. Nahm 1 Apr. 1978 110 p refs
(Contract NAS3-14302)
(NASA-CR-135411; Doc-R78AEG289) Avail: NTIS HC A06/MF A01 CSCL 13I

Rolling element fatigue lives of eleven alloys were evaluated. The eleven alloys studied were three nitriding alloys (Super Nitralloy, Nitralloy 135, and Nitralloy N), four case carburizing alloys (AISI 9310, CBS 600, CBS 1000M and Vasco X-2), and four throughhardening alloys (Vasco Matrix II,AISI W-1, AISI S-2 and AISI O-2). Several different heat treatments and/or melting processes were studied on the three carburizing alloy steels. Metallurgical analyses were made before and after the RC rig tests. Test data were statistically analyzed using the Weibull distribution function. B-10 lives were compared versus VIM-VAR AISI M-50 and carburized VAR AISI 9310, as reference alloys.
L.S

**N78-31428*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**AUTOMOTIVE TECHNOLOGY STATUS AND PROJECTIONS. VOLUME 1: EXECUTIVE SUMMARY**
M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft Jun. 1978 51 p refs
(Contract NAS7-100)
(NASA-CR-157593; JPL-Pub-78-71-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 13I

Fuel economy, exhaust emissions, multifuel capability, advanced materials and cost/manufacturability for both conventional and advanced alternative power systems were assessed. To insure valid comparisons of vehicles with alternative power systems, the concept of an Otto-Engine-Equivalent (OEE) vehicle was utilized. Each engine type was sized to provide equivalent vehicle performance. Sensitivity to different performance criteria was evaluated. Fuel economy projections are made for each engine type considering both the legislated emission standards and possible future emissions requirements. A.R.H.

**N78-31429*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**AUTOMOTIVE TECHNOLOGY STATUS AND PROJECTIONS. VOLUME 2: ASSESSMENT REPORT**
M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft Jun. 1978 414 p refs
(Contract NAS7-100)
(NASA-CR-157594; JPL-Pub-78-71-Vol-2) Avail: NTIS HC A18/MF A01 CSCL 13I

Current and advanced conventional engines, advanced alternative engines, advanced power train components, and other energy conserving automobile modifications which could be implemented by the end of this century are examined. Topics covered include gas turbine engines, Stirling engines, advanced automatic transmissions, alternative fuels, and metal and cera uic technology. Critical problems are examined and areas for future research are indicated. A.R.H.

**N78-31430#** Lockheed-California Co., Burbank.
**FLAW GROWTH IN COMPLEX STRUCTURE. VOLUME 2: TEST DATA Final Report, May 1975 - Sep. 1977**
T. R. Brussat, S. T. Chiu, and M. Creager Dec. 1977 164 p
(Contract F33615-75-C-3093)
(AD-A054744; LR-28272-Vol-2; AFFDL-TR-77-79-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 13/5

Sixty-eight structural specimens (26 joints and 42 stringer-reinforced panels) were machined, precracked, assembled and fatigue tested. (Volume 1 is a detailed technical discussion of the program.) Data are tabulated for each specimen. Data plots are also presented in which the test results are compared to analytical predictions. GRA

**N78-31431#** Northwestern Univ., Evanston, Ill. Dept. of Mechanical Engineering and Astronautical Sciences.
**THERMOMECHANICAL EFFECTS IN SLIDING WEAR**
Ralph A. Burton Apr. 1978 46 p refs
(Contract N00014-75-C-0761)
(AD-A055318) Avail: NTIS HC A03/MF A01 CSCL 20/11

When sliding occurs with significant frictional heating, thermoelastic deformation may lead to a transition from smoothly distributed asperity contact to a condition where the surfaces are supported by a few thermal asperities. This circumstance may be associated with a transition to a condition of severe wear because of the elevated contact pressure and temperature, and also because of production of tensile stresses. This second stress component may lead to heat checking whereupon the rough checked surface acts to abrade the mating material. The factors influencing transition are discussed, including wear, cooling, and hydrodynamic lubrication. The transitioned state is also discussed as to stress distribution, rate of movement of the contact patches and temperatures. Author (GRA)

**N78-31432#** Naval Underwater Systems Center, Newport, R.I.
**ROTARY EXPANDER ENGINE DEVELOPMENT PROGRAM**
Giovanni J. Silvestri 15 Jan. 1978 41 p refs
(AD-A055662; NUSC-TM-78-2012) Avail: NTIS

HC A03/MF A01 CSCL 10/1

This paper describes some results and the status of a program to develop a 250 hp(186 kW) rotary expander engine for use with an external combustion source or in a closed cycle power system. In the first phase of the program, parts from a Curtiss-Wright RC1-60 internal combustion engine were combined with a new housing, end plates and a set of rotary valves to produce the first rotary expander, the RE1-60. The RE1-60 was tested at a maximum power output of 155 hp(116 kW) at 4800 rpm when supplied with combustion gas at 1000 F(538 C) and 600 psia(4.14 MPa). Details of the RE1-60 and test results are presented. The second rotary expander, the RE1-11, was designed with the expander's kinematics similar to that of Wankel's earlier engines; the main shaft/eccentric is stationary while the rotor and housing rotate. Power take-off occurs from the housing. Compared to the RE1-60 this kinematic change eliminates two balance weights and a fly wheel, and permits location of the valves closer to the expander:s working chamber. Details of the RE1-11 design are given in the paper along with solutions to some challenging casting and fabrication problems. The current status of the RE1-11 fabrication program and plans for half-power testing are summarized. Author (GRA)

**N78-31433#** Naval Weapons Handling Lab., Colts Neck, N. J.
**DYNAMIC ANALYSIS OF SHIPPING CONTAINER SUSPENSION SYSTEM FOR THE CANISTER LAUNCHED VERSION OF THE HARPOON MISSILE RGM-84A-3A Final Report**
Y. Trask 1 Apr. 1978 98 p
(AD-A055719; NWHC-7760) Avail: NTIS HC A05/MF A01 CSCL 13/4

This center conducted an analysis to determine isolation system parameters for a shipping and storage container for the canister launched version of the HARPOON missile. This report presents the details of the analysis and information concerning the predicted shock and vibration forces on the packaged item as well as the container caused by the hazards of handling and transportation. A packaging configuration is presented, which uses isolators previously approved for the ASROC version of the HARPOON missile. Since this configuration adequately protects the weapon in its specified shock vibration environments. It is recommended that ASROC-version approved isolators be used in the proposed configuration. GRA

**N78-31434#** Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
**ROTATING ARM EXPERIMENTS FOR THE STABLE SEMI-SUBMERGED PLATFORM (SSP) MANEUVERING PREDICTIONS**
James A. Fein Sep. 1977 137 p
(AD-A055721; DTNSRDC/SPD-698-02) Avail: NTIS HC A07/MF A01 CSCL 14/2

This report contains the results of model experiments conducted on the rotating arm facility to determine the horizontal plane characteristic of a Stable Semi-Submerged Platform (SSP). Nondimensional coefficients for the side force, yaw moment, and roll moment at a wide range of speed, drift angle, draft, roll angle, positive and negative yaw rate and rudder deflections are reported in graphical form. Also, comparisons with straight line experiments are presented. The results presented provide a sufficient data base for simulation studies of craft turning. GRA

**N78-31435#** Hanford Engineering Development Lab., Richland, Wash.
**THREE-DIMENSIONAL INELASTIC ANALYSIS OF A SMALL LIQUID SODIUM VALVE**
E. O. Weiner Feb. 1978 198 p refs
(Contract EY-76-C-14-2170)
(HEDL-TME-77-91) Avail: NTIS HC A09/MF A01

A three dimensional inelastic analysis of a small liquid sodium valve for the fast flux test facility was conducted to assess ratcheting and creep damage at temperatures to 1200 F using the MARC-CDC finite element program. A single mesh of twenty node solid elements, representing the Y-type cylinder intersection was used for both the heat transfer and mechanical computer runs. Material behavior was governed by kinematic and creep strain hardening, and the loading consists of steady mechanical loads with cyclic fluid thermal transients. The resulting creep damage is significantly smaller than that of a corresponding axisymmetric analysis, and plastic strain were confined to a single region. ERA

**N78-31436#** Teledyne Continental Motors, Muskegon, Mich. General Products Div.
**AUTOMOTIVE DIESEL TECHNOLOGY PROGRAM Final Report, Jun. 1975 - Apr. 1977**
Stephen H. Hill Aug. 1977 124 p refs
(Contract EY-76-C-03-1099)
(SAN-1099-1) Avail: NTIS HC A06/MF A01

The preliminary design was finalized for a lightweight automotive diesel that can meet ERDA specification goals. Technology included in the concept design can meet the emission and fuel economy goals of 0.41HC/3.4CO/0.4NO/sub x/ and 25 miles per gallon on the Federal Urban Driving Cycle. The major conclusion reached are that a variable compression ratio swirl chamber diesel with variable injection timing and exhaust gas recirculation can: (1)achieve emissions of 0.4 HC/3.4 CO/0.40 NO/sub x/;(2)have fuel economy 55 percent better (MPG)than comparable gasoline engines; (3)gave an early introduction into production over present gasoline engine lines;(4)have a broad fuel tolerance (unleaded gasoline was run);and (5)be smaller in size and comparable in weight to existing gasoline engines. ERA

**N78-31437#** Rome Univ. (Italy). Facolta di Ingegneria.
**OFF DESIGN PERFORMANCE OF SUPERCHARGED TWO STROKE DIESEL ENGINES**
Andrea Dadone, Bernardo Fortunato, and Michele Napolitano 1977 22 p refs In ITALIAN; ENGLISH summary Presented at the 32d Natl. Congr. of the Assoc. Termotec. Ital., Rome, 20-23 Sep. 1977
(Contract CNR-CT-75.01135.07)
Avail: NTIS HC A02/MF A01

A theoretical model is outlined suitable for predicting the real-cycle of marine turbocharged two stroke diesel engines. A computational procedure for evaluating the overall off design performances of such an engine is also suggested. The theoretical predictions are in good agreement with the real cycle and the off design performances experimentally measured by an Italian company. Author (ESA)

**N78-31438#** Bari Univ. (Italy). Ist. di Costruzioni di Macchine.
**RELIABILITY IN THE DESIGN OF WELDED STRUCTURES [L'AFFIDABILITA DELLA PROGETTAZIONE DELLE STRUTTURE SALDATE]**
Bruno Atzori and Franco Corsi Sep. 1977 15 p refs In ITALIAN; ENGLISH summary Presented at the 5th Natl. Congr. of the Assoc. Ital. per l'Anal. delle Sollecitazioni, Bari, Italy, 29 Sep.-1 Oct. 1977
Avail: NTIS HC A02/MF A01

It is shown how the 'uniform scatter band' concept can be used as a useful basis for a more consistent approach to the design of welded structures. The proposed approach considers the reliability and the safety factor as two elements both necessary in design, because of the difference between the causes which influence each of them. As an example of application the 'constant reliability' SN lines for welded joints in steel are computed. Also the uniform scatter bands for welded joints in several materials as given in the literature are reported, to show the possibility of extension of the exposed concepts. Author (ESA)

**N78-31439#** National Centre of Tribology, Risley (England). European Space Tribology Lab.
**EVALUATION OF AMPEP JOURNAL BEARINGS FOR ISEE-B BOOM HINGE**
K. Parker Paris ESA Oct. 1977 31 p
(Contract ESTEC-3258/77)
(ESA-ESTL-29; ESA-CR(P)-1087) Avail: NTIS HC A03/MF A01

In support of work on the ISEE-B boom hinge, two journal bearing and titanium shafts assemblies were tested in vacuum over a range of temperature from +50 C to -40 C. Each assembly incorporated the Ampep dry-bearing liner material 'Fibreslip' as a lubricant. Because the different thermal expansions of the aluminum bearing housing and titanium shaft could cause substantial torque increases at low temperatures, the amount of

shaft clearance to be specified was of vital importance. Two assemblies, having different clearances, were tested under no-load conditions and then with a 20 kg load applied radially to the bearing housing, all tests being performed in a vacuum of about 5 x 10 to the minus 7th power mm Hg. The first assembly exhibited predictable torque behavior but the second, with lower clearances in the assembly, gave some very high torques. Both assemblies were examined after the tests to determine the degree of wear and change of surface properties which had occurred during a total of approximately 50 revolutions. Author (ESA)

**N78-31440#** Maryland Dept. of Transportation, Baltimore.
**THE OUTLOOK FOR AUTOMOTIVE FUEL SUPPLIES, ALTERNATIVE VEHICLE ENGINES, AND POTENTIAL IMPLICATIONS FOR TRANSPORTATION TAX STRUCTURES (1985-2000) Final Report**
William Barron, Edwin Crawford, and Morton Weinberg Feb. 1978 206 p refs Prepared in cooperation with Johns Hopkins Univ., Baltimore
(PB-279679/5; FR-2) Avail: NTIS HC A10/MF A01 CSCL 13F

Potential developments in automotive fuel supplies, alternatives to the Otto Cycle engine, and implications of projected developments in these areas for state road user tax arrangements are examined. Alternative heat engines, electric vehicles, and fuel cells are considered in regard to the state of their technological development and ability to utilize nonstandard fuels. Alternative taxing arrangements briefly evaluated are: BTU based tax on liquid fuels; increased annual registration fees for alternatively powered vehicles; electric flow recharge metering; tax on traction batteries; periodic odometer readings; and road surface checkpoint metering. GRA

**N78-31441#** Minicars, Inc., Goleta, Calif.
**RESEARCH SAFETY VEHICLE. PHASE 2, VOLUME 2: COMPREHENSIVE TECHNICAL RESULTS Final Report, Jul. 1975 - Dec. 1976**
N. DiNapoli, M. Fitzpatrick, C. Strother, D. Struble, and R. Tanner Nov. 1977 609 p
(Contract DOT-HS-5-01215)
(PB-280153/8; DOT-HS-803250-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 13F

Phase 1 identified trends leading to the desired national social goals of the mid-1980's in vehicle crashworthiness, crash avoidance, damageability, pedestrian safety, fuel economy, emissions and cost, and characterized an RSV to satisfy them. In Phase 2 an RSV prototype was designed, developed and tested to demonstrate the feasibility of meeting these goals simultaneously. Although further refinement is necessary to assure operational validity, in all categories the results meet or exceed the most advanced performance specified by the presidential task force on motor vehicle goals beyond 1980. GRA

**N78-31442#** Minicars, Inc., Goleta, Calif.
**RESEARCH SAFETY VEHICLE. PHASE 2, VOLUME 3A: SUBCONTRACTOR REPORTS: THE BUDD COMPANY, MAN FACTORS, INC., MARD ANALYSIS CORPORATION, MONSANTO RESEARCH CORPORATION Final Report, Jul. 1975 - Dec. 1976**
Nov. 1977 336 p refs
(Contract DOT-HS-5-01215)
(PB-280154/6; DOT-HS-803251-Vol-3A) Avail: NTIS HC A15/MF A01 CSCL 13F

In Task 1, assistance was provided in evolving the vehicle test shell designs and in assembling test shell number DV4-7 using more typical automotive assembly and welding practices. The objective of Task 2 was to take the basic concept and structural design and develop it to be producible at the volume of 300,000 units per year with particular emphasis on the sheet metal body-in-white, and foam filling of that body. This design was compared with cost and weight data for the 1975 Pinto car. Facilities and tooling requirements were analyzed relative to those required for the 1975 Pinto. A study of the foaming requirements for the vehicle was made with recommended production facilities. A final vehicle weight and cost relative to the 1975 Pinto are presented. GRA

**N78-31443#** Minicars, Inc., Goleta, Calif.
**RESEARCH SAFETY VEHICLE. PHASE 2, VOLUME 3B: SUBCONTRACTOR REPORTS. RCA LABORATORIES, STANFORD RESEARCH INSTITUTE, SYSTEM TECHNOLOGY, INC., UNIVERSITY OF UTAH Final Report, Jul. 1975 - Dec. 1976**
Nov. 1977 378 p refs
(Contract DOT-HS-5-01215)
(PB-280155/3; DOT-HS-803252-Vol-3B) Avail: NTIS HC A17/MF A01 CSCL 13F

The electronics portion of a larger program aimed at the development of a Research Safety Vehicle (RSV) for the mid 1980 is reviewed. The specific objectives for this phase of the program were to develop and test (1) a noncooperative radar system for the purpose of obstacle warning and collision mitigation; and (2) electronic central display system that provides the driver with normal driving-related information together with emergency warning messages if a malfunction occurs in certain safety-related parts of the car. To perform these sometimes complex functions efficiently, reliably, and in a very short time, microcomputers are used that are interfaced with a number of sensors as well as with the radar. GRA

**N78-31444#** National Bureau of Standards, Washington, D. C. Structures, Materials and Safety Div.
**SOLAR ENERGY SYSTEMS. STANDARDS FOR RUBBER SEALS Final Report**
Robert D. Stiehler, Arthur Hockman, Edward J. Embree, and Larry W. Masters Mar. 1978 66 p
(PB-280114/0; NBSIR-77-1437) Avail: NTIS HC A04/MF A01 CSCL 11A

Thirty preformed and liquid applied seals were evaluated in the laboratory using modified ASTM standard test methods to obtain data needed to prepare the standards. Also, studies were performed to develop a test method for determining the effects of outgassing on the transmittance of solar collector covers. The results of the laboratory tests are presented and standards for rubber seals in solar energy systems are proposed. GRA

## 38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

**N78-31445#** Hanford Engineering Development Lab., Richland, Wash.
**DEVELOPMENT OF ULTRASONIC EXAMINATION METHODS FOR AUSTENITIC STAINLESS STEEL WELD INSPECTION**
S. J. Mech, I. E. Michaels, J. S. Emmons, and M. M. Sugiyama Aug. 1977 29 p refs
(Contract EY-76-C-14-2170)
(HEDL-SA-1348) Avail: NTIS HC A03/MF A01

Signal acquisition and analysis techniques were developed to permit locating notches placed in an austenitic stainless steel pipe weld. Ultrasonic techniques presented utilize refracted longitudinal and shear inspection beams with a dual element, pitch-catch transducer. Sources of grain noise and the metallurgical implications of inspecting austenitic stainless steel welds are reviewed. Data were analyzed in both time and frequency domains and a simple frequency moment algorithm was developed which is sensitive to defect signal and somewhat insensitive to grain noise. Data were also used to train an adaptive learning network and the results obtained demonstrate only slight sensitivity to grain noise. ERA

**N78-31446#** Kentucky Univ., Lexington. Dept. of Statistics.
**MULTISTATE RELIABILITY MODELS: A SURVEY Interim Report**
Emad El-Neweihi and Frank Proschan (Florida State Univ., Tallahassee) Apr. 1978 29 p refs
(Grant AF-AFOSR-3322-77)
(AD-A055111; TR-123; AFOSR-78-0947TR) Avail: NTIS HC A03/MF A01 CSCL 14/4

For a long time, the vast majority of the models in reliability theory have concentrated on the case in which both components and systems assume only two possible states; functioning and failed. Unfortunately, this represents a gross oversimplification of the many real life situations in which both components and systems actually assume a variety of states ranging from perfect operation to complete failure. More recently, papers have appeared which treat the more sophisticated and more realistic situations in which components and systems may assume many states. In the present paper, a survey is made of earlier work, but more especially of some quite recent work (some completed, some still in progress) by the relatively small number of researchers active in this important new area of reliability. It is becoming apparent that this research will generate results not only of value in reliability applications, but also of independent interest in multivariate statistical analysis. Author (GRA)

**N78-31447#** George Washington Univ., Washington, D. C. Inst. for Management Science and Engineering.

**ANALYZING AVAILABILITY AND READINESS USING TRANSFER FUNCTION MODELS AND CROSS SPECTRAL ANALYSIS**

Nozer D. Singpurwalla 29 Mar. 1978 32 p refs
(Contracts N00014-75-C-0729; AT(49-24)-0211)
(AD-A055724; SERIAL-T-369) Avail: NTIS HC A03/MF A01 CSCL 14/4

Looking at the literature of reliability and life testing one does not see much on the use of the powerful methods of time series analysis. This paper shows how the methods of multivariate time series analysis can be used in a novel way to investigate the interrelationships between a series of operating (running) times and a series of maintenance (down) times of a complex system. Specifically, we apply the techniques of cross spectral analysis to help us obtain a Box-Jenkins type transfer function model for the running times and the down times of a nuclear reactor. A knowledge of the interrelationships between the running times and the down times is useful for an evaluation of maintenance policies, for replacement policy decisions, and for evaluating the availability and the readiness of complex systems. GRA

**N78-31448#** Southwest Research Inst., San Antonio, Tex. Quality Assurance Systems and Engineering Div.

**DETAILED ANALYSIS OF THE FUNDAMENTAL ULTRASONIC RESPONSE DATA FROM STAINLESS STEEL STRESS CORROSION CRACK SPECIMENS**

J. T. McElroy Feb. 1978 103 p Sponsored by Elec. Power Res. Inst.
(EPRI-NP-676-SR; TPS-75-620) Avail: NTIS HC A06/MF A01

After the Boiling Water Reactor (BWR) stress corrosion cracking incidents on 4 and 10 inch stainless steel piping, a round-robin ultrasonic examination of piping removed from service was organized. Five teams participated in the program, using both a standard procedure and the individual team procedure. Approximately 400 data points were collected. These data consist of oscilloscope recordings of the RF (radio frequency) waveform and a linear spectrum analysis of the signal reflected from the crack specimens. The ultrasonic response data compiled are summarized. ERA

**N78-31449#** California Univ., Los Angeles. Dept. of Chemical, Nuclear, and Thermal Engineering.

**PROBABILITY INTERVALS FOR THE RELIABILITY OF COMPLEX SYSTEMS USING MONTE CARLO SIMULATION**

Yum Tong Lee and Steven L. Salem Dec. 1977 45 p refs (Grant NSF OEP-75-20318)
(PB-280191/8; UCLA-ENG-7758) Avail: NTIS HC A03/MF A01 CSCL 14D

Uncertainty assessment by a Monte Carlo simulation is used to produce an empirical Bayes estimate of the probability intervals of TOP event unreliability. The Monte Carlo simulation processed by propagating basic event probabilities, chosen randomly from input probability distributions through the tree, and producing an empirical TOP event probability distribution after combining the results of many trials. A new computer code, LIMITS, was used in several examples. GRA

**N78-31450#** National Technical Information Service, Springfield, Va.

**NONDESTRUCTIVE ULTRASONIC TESTING AND INSPECTION, VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Final Report, May 1976 - Apr. 1977**

Guy E. Habercom, Jr. Jun. 1978 152 p
(NTIS/PS-78/0567/4) Avail: NTIS HC $28.00/MF $28.00 CSCL 14B

Ultrasonic equipment and techniques for nondestructive inspection/testing of materials and fabrication processes are investigated in these reports obtained from worldwide literature. GRA

**N78-31451#** National Technical Information Service, Springfield, Va.

**NONDESTRUCTIVE ULTRASONIC TESTING AND INSPECTION, VOLUME 3. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Final Report, May 1977 - Mar. 1978**

Guy E. Habercom, Jr. Jun. 1978 177 p Supersedes NTIS/PS-77/0404; NTIS/PS-76/0424
(NTIS/PS-78/0568/2; NTIS/PS-77/0404; NTIS/PS-76/0424) Avail: NTIS HC $28.00/MF $28.00 CSCL 14B

For abstract, see N78-31450.

**N78-31452#** National Technical Information Service, Springfield, Va.

**NONDESTRUCTIVE ULTRASONIC TESTING AND INSPECTION, VOLUME 4. CITATIONS FROM THE NTIS DATA BASE Final Report, May 1976 - Apr. 1977**

Guy E. Habercom, Jr. Jun. 1978 139 p
(NTIS/PS-78/0565/8) Avail: NTIS HC $28.00/MF $28.00 CSCL 14B

For abstract, see N78-31450.

**N78-31453#** National Technical Information Service, Springfield, Va.

**NONDESTRUCTIVE ULTRASONIC TESTING AND INSPECTION, VOLUME 5. CITATION FROM THE NTIS DATA BASE Final Report, May 1977 - Mar. 1978**

Guy E. Habercom, Jr. Jun. 1978 129 p Supersedes NTIS/PS-77/0402; NTIS/PS-76/0423; NTIS/PS-75/271
(NTIS/PS-78/0566/6; NTIS/PS-77/0402) Avail: NTIS HC $28.00/MF $28.00 CSCL 14B

For abstract, see N78-31450.

# 39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

**N78-31454** Illinois Inst. of Tech., Chicago.

**ON BOUNDS AND APPROXIMATE SOLUTIONS FOR A PROBLEM IN NON-LINEAR CREEP THEORY WITH APPLICATIONS TO BRITTLE DAMAGE Ph.D. Thesis**

Paul Gregory Reichel 1977 65 p
Avail: Univ. Microfilms Order No. 78-11823

New bounds were obtained for stresses in pressure vessels subject to primary or secondary creep and the effect of elastic strains. In the case of secondary creep a previously defined monotone nonincreasing sequence of approximate solutions was modified to produce a new sharper upper bounds. By means of a secant method, a monotone nondecreasing sequence of lower bound approximations was obtained. This sequence is uniformly convergent and it furnishes new lower bounds to the exact solution. Results are applied to the estimation of the times of initiation of rupture using the Kachanov theory of brittle damage.
Dissert. Abstr.

**N78-31455** California Univ., Berkeley.

**DEFLECTION OF A TRANSVERSELY LOADED SPINNING DISK Ph.D. Thesis**

Richard Carter Benson 1977 81 p
Avail: Univ. Microfilms Order No. 78-12487

The steady deflection of a spinning disk with a transverse load is studied. Linear equations of motion are derived and the boundary conditions are listed. Bending stress and in plane stress due to rotation are taken into account. When bending stresses are ignored the resulting physical system is that of a spinning membrane with a transverse load. Over an outer annulus the membrane can support transverse waves, while over an inner circular portion deflections diminish away from a load. A study of the eigenvalues and eigenfunctions of steady state deflections in the membrane leads to the conclusion that the membrane cannot support an arbitrary transverse load. When bending stresses are retained in the problem it is possible to obtain a solution for a transversely loaded spinning disk. Some numerical results are calculated for the disk with a single concentrated load. The most flexible disks have a response exhibiting the types of deflections predicted for a membrane. Dissert. Abstr.

**N78-31456** Illinois Inst. of Tech., Chicago.
**AUTOMATED DESIGN OF STRUCTURES SUBJECT TO STRESS, DISPLACEMENT AND TEMPERATURE CONSTRAINTS Ph.D. Thesis**
Birendra Prasad 1977 296 p
Avail: Univ. Microfilms Order No. 78-11821

A simultaneous automated design procedure, for obtaining minimum mass design of thermally cooled structures subjected to combined thermal and mechanical loadings with strength, displacement, thermal, minimum and maximum size constraints, is described. The procedure is based on a mathematical programming method using the Sequence of Unconstrained Minimization Technique. A cubic extended interior penalty function formulation which is designed to minimize the error in the approximation to the Hessian matrix, is presented. Several other approximation concepts and the computation of analytical derivatives of constraints are described. In conjunction with Newton's method these concepts help reduce computational time and increase the order of the structural design problem that can be solved. Dissert. Abstr.

**N78-31457** Aeronautical Research Labs., Melbourne (Australia).
**CONSTANT-AMPLITUDE AND PROGRAM-LOAD FATIGUE TESTS AT LOW CYCLIC FREQUENCIES ON THICK ALUMINIUM ALLOY PIN JOINTS**
J. Y. Mann, F. G. Harris, and G. W. Revill Sep. 1977 31 p refs
(ARL-Struc-Rept-365; AR-000-850) Copyright. Avail: Issuing Activity

The fatigue behavior of 32 mm thick 2L65 aluminium alloy lugs loaded through 19 mm diameter steel pins was investigated. At high alternating stresses, constant-amplitude test results fall within the relevant data band in ESDU Data Sheet 72020. However, additional data are needed to clarify the fatigue performance of thick lugs for lives exceeding about 500,000 cycles. Under program-loading, the cycles applied at two of the intermediate stress levels exceeded the maximum experimental endurances obtained under constant-amplitude at the same stress levels. In addition, the actual lives of specimens under program-loading were about 10 times those predicted from the constant-amplitude data using the simple Palmgren-Miner hypothesis. Static tests on about 20 of the fatigued pin-lug joints indicate that fatigue crack geometry may have an important influence on the residual strength of such a connection. A.R.H.

**N78-31458** Aeronautical Research Labs., Melbourne (Australia).
**RESIDUAL STRENGTH TESTS ON FATIGUE-CRACKED MULTI-FASTENER SPECIMENS OF EXTRUDED L65 ALUMINIUM ALLOY**
J. Y. Mann, F. G. Harris, and G. W. Revill Jan. 1978 35 p refs
(ARL-Struc-Note-444; AR-000-1111) Copyright. Avail: Issuing Activity

Static strength tests were carried out on fatigue-cracked multi-fastener joint specimens of L65 aluminum alloy to determine the influence of cracks of various shapes, sizes and locations on the residual strength. The residual static strengths were found to be considerably less than would have been expected on a simple percentage loss-of-area basis; whereas simple fracture mechanics analysis using models of a semi-elliptical surface crack and a semi-circular corner crack at a hole consistenly predicted lower failing loads than those obtained experimentally. For the larger crack sizes, the percentage differences between actual and predicted failing loads were greater than for small crack sizes. Multiple fatigue cracking at different locations and the possibilities of interactions between cracks are complicating factors which introduce considerable uncertainties in extending simple fracture mechanics analyses methods to more complex practical cases. G.Y.

**N78-31459*#** Michigan State Univ., East Lansing. College of Engineering.
**MEASUREMENTS OF MIXED-MODE CRACK SURFACE DISPLACEMENTS AND COMPARISON WITH THEORY Final Report**
Nicholas J. Altiero, Jr. and William N. Sharpe, Jr. 5 Sep. 1978 90 p refs
(Grant NsG-3101)
(NASA-CR-157579) Avail: NTIS HC A05/MF A01 CSCL 20K

A theoretical and an experimental technique is used to determine crack surface displacements under mixed-mode conditions. Crack surface displacements proved to be quite useful in mode 1 fracture analysis in that they are directly related to strain energy release rate and stress intensity factor. It is felt that similar relationships can be developed for the mixed-mode case. A boundary-integral method was developed for application to two-dimensional fracture mechanics problems. This technique was applied to the mixed-mode problem. A laser interferometry technique, for measurement of crack surface displacements under mixed-mode conditions, is presented. The experimental measurements are reported and the results of the two approaches are compared and discussed. L.S.

**N78-31460#** Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
**LABORATORY FOR FATIGUE LIFE EVALUATION RESEARCH REPORTS, ISSUE 8**
Von H. Klaetschke Jun. 1978 376 p refs
(ICAF-1045) Avail: NTIS HC A17/MF A01

The best known concepts including their adherent parameters are described and compared to each other. Within these concepts much effort was related to the determination of the local stress-strain behavior at the notch root, but conventional methods were kept for the damage accumulation. Therefore, the question arises whether improvements of details of these fatigue analysis processes results in a satisfactory overall improvement of the concept. Some research work was started which leads on a more transparent way to a life prediction based on local elasto-plastic stress-strain behavior. It was the purpose of these research efforts to help clarify whether a realistic life prediction can be expected if within the concept the local stress-strain behavior is correctly simulated and the damage due to local stress-strain cycles is linearly accumulated. G.Y.

**N78-31461#** Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
**DETERMINATION OF FATIGUE PERFORMANCE DATA ON STRUCTURAL MATERIALS UNDER TYPIFIED RANDOM LOADING: AXIALLY LOADED NOTCHED SPECIMENS OF MILD STEEL RR St 52 - 3 (SAE 1030)**
E. Gassner and H.-G. Koebler 1978 63 p refs In GERMAN; ENGLISH summary
(TB-127(1978); ICAF-1046) Avail: NTIS HC A04/MF A01

Fatigue performance data obtained from fatigue tests characterize the fatigue strength behavior of structural components or notched specimens respectively under typified random loading. In special cases fatigue performance data enable fatigue life predictions of structural components. Fundamental aspects of the determination of fatigue performance data and test results of the mild steel S 52 3 (SAE 1030) are presented and discussed. The necessity of typifying the random load sequence is considered. Technical details of the testing procedure which should be regarded are mentioned. J.M.S.

**N78-31462#** Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
**INVESTIGATION TO COMPUTE THE DISTRIBUTION OF FATIGUE LIFE BY MONTE-CARLO METHODS**

H. P. Lehrke 1978 43 p refs In GERMAN; ENGLISH summary
(FB-138(1978); ICAF-1047) Avail: NTIS HC A03/MF A01

Provided, that the individual fatigue life of specimens can be calculated as a function of parameters which describe their endurable strength and their loading, and provided, that the distributions of these parameters are known, the distribution of fatigue life can be computed by Monte Carlo methods up to the tails of the distribution with high numerical accuracy. However, it is shown that the range of small probabilities to failure of the life distributions is influenced most by the extreme values of the parameters. Therefore, their distributions must be known up to the tails in order to get results which can be used for a reliable prediction. J.M.S.

**N78-31463#** National Aerospace Lab., Amsterdam (Netherlands).
**ENVIRONMENTAL EFFECTS ON FATIGUE OF ALUMINIUM AND TITANIUM ALLOYS**
R. J. H. Wanhill Jun. 1977 40 p refs
(NLR-MP-77019-U) Avail: NTIS HC A03/MF A01

Environmental effects on the fatigue strength and crack propagation resistance of aluminum and titanium alloys are reviewed. Particular attention is paid to the influence of air and aqueous environments on aerospace structural materials. Recommendations are made for future research activity, notably with regard to material selection and service performance. Author

**N78-31464*#** Wiggins (J. H.) Co., Redondo Beach, Calif.
**MODEL VERIFICATION OF LARGE STRUCTURAL SYSTEMS Final Report, 13 Apr. 1976 - 15 Jul. 1978**
L. T. Lee and T. K. Hasselman Jul. 1978 241 p refs
(Contract NAS8-31950)
(NASA-CR-150811; TR-78-1300) Avail: NTIS HC A11/MF A01 CSCL 20K

A computer program for the application of parameter identification on the structural dynamic models of space shuttle and other large models with hundreds of degrees of freedom is described. Finite element, dynamic, analytic, and modal models are used to represent the structural system. The interface with math models is such that output from any structural analysis program applied to any structural configuration can be used directly. Processed data from either sine-sweep tests or resonant dwell tests are directly usable. The program uses measured modal data to condition the prior analystic model so as to improve the frequency match between model and test. A Bayesian estimator generates an improved analytical model and a linear estimator is used in an iterative fashion on highly nonlinear equations. Mass and stiffness scaling parameters are generated for an improved finite element model, and the optimum set of parameters is obtained in one step. A.R.H.

**N78-31465*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
**DESIGN AND FABRICATION OF A RING-STIFFENED GRAPHITE-EPOXY CORRUGATED CYLINDRICAL SHELL Final Report**
Read Johnson, Jr. Aug. 1978 77 p refs
(Contract NAS1-14547)
(NASA-CR-3026; MDC-G7330) Avail: NTIS HC A05/MF A01 CSCL 20K

Design and fabrication of supplement test panels that represent key portions of the cylinder are described, as are supporting tests of coupons, sample joints, and stiffening ring elements. The cylindrical shell is a ring-stiffened, open corrugation design that uses T300/5208 graphite-epoxy tape as the basic material for the shell wall and stiffening rings. The test cylinder is designed to withstand bending loads producing the relatively low maximum load intensity in the shell wall of 1,576 N/cm. The resulting shell wall weight, including stiffening rings and fasteners, is 0.0156 kg/m. The shell weight achieved in the graphite-epoxy cylinder represents a weight saving of approximately 23 percent, compared to a comparable aluminum shell. A unique fabrication approach was used in which the cylinder wall was built in three flat segments, which were then wrapped to the cylindrical shape. Such an approach, made possible by the flexibility of the thin corrugated wall in a radial direction, proved to be a simple approach to building the test cylinder. Based on tooling and fabrication methods in this program, the projected costs of a production run of 100 units are reported. L.S.

**N78-31466*#** Chicago Univ., Ill. Dept. of Geophysical Sciences.
**ON THE MULTIPLICITY OF SOLUTIONS OF THE INVERSE PROBLEM FOR A VIBRATING BEAM**
Victor Barcilon Apr. 1978 19 p refs
(Grant NsG-7247; Contract N00014-76-C-0034; NR Proj. 041-476)
(NASA-CR-157572; AD-A054248) Avail: NTIS HC A02/MF A01 CSCL 13/13

The 2 to the N-1 power fold multiplicity of solutions found by Boley and Golub in their study of the inverse problem for N x N symmetric, pentadiagonal matrices contrasts with the unicity of the solution of the inverse problem for an inhomogeneous, discrete beam. The reason for this discrepancy is elucidated and can be traced to the different properties of the spectral data used in the two cases. Author (GRA)

**N78-31467#** General Electric Co., Syracuse, N.Y. Heavy Military Equipment Dept.
**IMPACT OF ROCK DEBRIS ON A SIMPLY SUPPORTED BEAM**
R. Mann May 1978 118 p
(AD-A055077; R78EMH5) Avail: NTIS HC A06/MF A01 CSCL 13/13

Sedimentary and igneous rock projectiles were fired at the center of a simply supported aluminum beam in a series of impact tests. An experimental investigation was conducted to determine: dynamic response of the beam, localized permanent deformation of the beam in the region of impact, and fracturing behavior of weak and strong sandstone. The experimental results are complimented with the development of analytical impact models for both fracturing and nonfracturing rock projectiles. An impact apparatus was developed for firing regular and irregular shaped projectiles. Response of strain gages attached to the 0.25 x 1.00 x 18.00 in., 6061T6 aluminum beam, were recorded on a storage oscilloscope and oscillograph recorder. 16 mm high speed films of the impact process, were taken at just under 6000 frames/s. These films provided projectile and beam displacement data both during and after impact and also the means of determining the time duration of impact in the case of single impact, in addition to time between impacts in the case of multiple impact. GRA

**N78-31468#** Naval Ship Research and Development Center, Annapolis, Md.
**TRANSVERSE COMPRESSIONAL DAMPING IN THE VIBRATORY RESPONSE OF ELASTIC-VISCOELASTIC-ELASTIC BEAMS**
B. E. Douglas May 1978 35 p refs
(SF43452702)
(AD-A054769; DTNSRDC-78-046) Avail: NTIS HC A03/MF A01 CSCL 20/11

The effects of transverse compressional damping on the vibratory response of three-layer elastic-viscoelastic-elastic beams are considered both analytically and experimentally in a mechanical impedance format. The relative importance of this type of damping is assessed by comparison to shear damping mechanisms inherent in the composite using the Mead and Markus model. Results suggest the effects from compressional damping have a relatively narrow frequency bandwidth centered at the compressional (delamination) frequency, omega sub c, of the composite. Compressional damping is shown to have a minimal effect on the transverse damping response of thin three-layer damped beams for frequencies significantly less than omega sub c, where a shear damping model provides a better description of dynamic response. Author (GRA)

**N78-31469#** Forest Products Lab., Madison, Wis.
**HARDBOARD-WEBBED I-BEAMS: EFFECTS OF LONG-TERM LOADING AND LOADING ENVIRONMENT Forest Service Research Paper**
Michael J. Superfesky and Terry J. Ramaker 1978 18 p refs
(AD-A055006; FSRP-FPL-306) Avail: NTIS HC A02/MF A01 CSCL 11/12

Twelve foot and 6 foot I-beams with webs of two different hardboard materials and plywood were subjected to constant loads in three different humidity environments. After 17,000 hours of test, the performance of the hardboard-webbed I-beams appears to be at least comparable to that of I-beams with plywood webs. Results of this study will be useful to researchers, designers, and building code officials for judging the acceptability of wood-base materials in structural components such as I-beams. Author (GRA)

**N78-31470#** Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.

**CRACK TIP PLASTICITY IN DYNAMIC FRACTURE MECHANICS Interim Report**

J. D. Achenbach and M. F. Kanninen Apr. 1978 25 p refs Prepared in cooperation with Battelle Mem. Inst., Columbus, Ohio

(Contracts N00014-76-C-0063; N00014-77-C-0576)

(AD-A055159; NU-SML-TR-78-1) Avail: NTIS HC A02/MF A01 CSCL 20/11

The objective of this work is to develop a procedure by which crack tip plasticity can be taken directly into account in rapid crack propagation. To set the stage, a background description of linear elastic dynamic fracture mechanics is first given. Existing solutions for dynamic crack propagation and for quasistatic crack growth accompanied by crack tip plasticity are reviewed. It is found that existing dynamic plastic fracture solutions are essentially confined to strip yield (Dugdale model) plastic zones that are collinear with the crack. The ultimate goal of the research reported in this paper is to provide the basis of a computational procedure for plastic dynamic crack propagation in structures of engineering interest. The prerequisite for such a development is knowledge of the nature of the crack tip singularity, which can be obtained via an asymptotic analysis in which attention is focused on the very near crack tip region. Here we have considered the specific case of crack propagation in antiplane strain (Mode III). The results suggest some interesting general conclusions, and the analysis has pointed the way to the solution of the Mode I problem. GRA

**N78-31471#** Wisconsin Univ. - Madison. Dept. of Engineering Mechanics.

**TIME SERIES DETERMINATION OF TRANSFER FUNCTIONS IN RANDOM FATIGUE**

T. C. Huang, Vinod K. Nagpal, and K. S. Shen Dec. 1977 46 p

(Contract N00014-76-C-0825)

(AD-A055656; UW/RF-2) Avail: NTIS HC A03/MF A01 CSCL 20/11

Time series determination of the transfer function which relates the input random excitation and the output response in random fatigue experiment is established. This process involves determination of univariate time series of input and output, transfer function and noise models, and the transfer function-noise model. Author (GRA)

**N78-31472#** Brown Univ., Providence, R. I. Engineering Div.

**CONTINUING CRACK TIP DEFORMATION AND FRACTURE FOR PLANE-STRAIN CRACK GROWTH IN ELASTIC-PLASTIC SOLIDS**

J. R. Rice and E. P. Sorensen Oct. 1977 38 p refs

(Contract EY-76-S-02-3084)

(COO-3084-56) Avail: NTIS HC A03/MF A01

Analysis of the deformation field consistent with a Prandtl stress distribution traveling with an advancing plane strain crack reveals the functional form of the near tip crack profile in an elastic-plastic solid. The crack opening is shown to have the form delta approximately r ln (const./r) at distance r from the tip. This observation coupled with data generated from finite element investigations of growing cracks in small scale yielding permits the construction of a relation characterizing the deformation at an extending crack tip. A crack growth criterion consisting of the attainment of a critical opening at a small characteristic material distance from the tip was adopted. Predictions of the stability of a growing crack for both small scale yielding specimens and those subject to general yielding are discussed. ERA

**N78-31473#** Oak Ridge National Lab., Tenn.

**MECHANICAL PROPERTIES TEST DATA FOR STRUCTURAL MATERIALS Quarterly Progress Report, period ending 31 Jan. 1978**

M. R. Hill, comp. Mar. 1978 383 p refs

(Contract W-7405-eng-26)

(ORNL-5380; PR-18) Avail: NTIS HC A17/MF A01

Collected results of all structural materials mechanical properties test programs sponsored by the Reactor Research and Technology and the Nuclear Power Development divisions of the Department of Energy during the period from Oct. 31, 1977 to Jan. 31, 1978 are presented. Author (ERA)

**N78-31474#** California Univ., Livermore. Lawrence Livermore Lab.

**FUNDAMENTAL STUDY OF CRACK INITIATION AND PROPAGATION**

D. M. Norris, Jr., J. E. Reaugh, B. Moran, D. F. Quinones, and M. L. Wilkins 21 Dec. 1977 29 p refs Presented at the Plastic Fracture Public Information Meeting, Palo Alto, Calif., 14-15 Feb. 1978

(Contract W-7405-eng-48)

(UCRL-80478; Conf-780207-1) Avail: NTIS HC A03/MF A01

The objective is to determine the fracture toughness of A533B-1 steel by computer modeling Charpy V-notch tests. A computer model of ductile fracture was developed that predicts fracture initiation. The model contains a set of material-dependent parameters obtained by computer simulations of small specimen tests. The computer calculations give detailed stress and strain histories up to the time of fracture, which are used to determine the model parameter values. The calibrated fracture model, that correctly predicts fracture initiation (and initiation energy) in the Charpy specimen may then be used to simulate tests of accepted fracture-toughness specimens and hence obtain fracture toughness. The model parameters were calibrated to predict fracture in four different test specimens: two different notched-tension specimens, a simple tension specimen, and a precracked compact-tension specimen. The model was then used in a computer simulation of the Charpy V-notch specimen to initiate and advance a flat fracture. Results were compared with interrupted Charpy tests. ERA

**N78-31475#** California Univ., Livermore. Lawrence Livermore Lab.

**MEASURING AND PREDICTING THE DYNAMIC EFFECTS OF A CONFINED THIN METAL PLATE PULSE HEATED INTO THE LIQUID-VAPOR REGIME Ph.D. Thesis**

R. C. Baxter 31 Dec. 1977 159 p refs

(Contract W-7405-eng-48)

(UCRL-52375) Avail: NTIS HC A08/MF A01

Lead targets 0.025 mm and 0.05 mm thick were contained between a thin titanium tamping layer and a thick layer of fused quartz with several different gap widths between the lead and the confining surfaces. After being heated by an electron beam for about 50 ns, lead specimens expanded to a state of approximately half liquid and half vapor. Measurements of the stress in the quartz and the velocity of the tamper produced by the expanding lead were compared with one dimensional hydrodynamic computer program predictions. Measured and predicted peak stresses in the quartz for no gaps were approximately 12 kilobars and agreed within one kilobar. Peak stresses decreased rapidly with gap size to values, at 0.02 mm gaps, of about one kilobar for the 0.025 mm lead targets and five kilobars for the 0.05 mm targets. Predictions and measurements of tamper velocity were within 10 percent only when the lead and confining walls were in close contact. These differences are attributed primarily to separation of the liquid and vapor phases during the expansion. ERA

**N78-31476#** Bari Univ. (Italy). Inst. di Costruzioni di Macchine.

**AN INTERACTIVE PROGRAM FOR THE ANALYSIS OF FATIGUE DATA [UN PROGRAMMA INTERATTIVO PER L'ANALISI DEI RISULTATI DI PROVE DI FATICA]**

Bruno Atzori, Umberto Bozzo (Centro Studi e Appl. in Tecnol. Avanzate), and Lavinia Miglionico (Centro Studi e Appl. in Tecnol. Avanzate) Sep. 1977 13 p refs In ITALIAN; ENGLISH

summary Presented at the 5th Natl. Congr. of the Assoc. Ital. per l'Anal. delle Sollecitazioni, Bari, Italy, 29 Sep.-1 Oct. 1977 Avail: NTIS HC A02/MF A01

An interactive computer program is described aimed at simplifying re-analysis of fatigue data. The present program is limited to welding data for aluminum alloys but may be used in more general circumstances. Comparison is given with the case of a butt joint analyzed using conventional techniques. ESA

# 42 GEOSCIENCES (GENERAL)

No abstracts in this category.

# 43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

**N78-31477** Syracuse Univ., N. Y.
**SEDIMENTARY GEOCHEMISTRY OF CARBONATE-SILICATE CYCLIC SEDIMENTATION IN DEEP SEA Ph.D. Thesis**
Satoshi Yanamoto 1977 218 p
Avail: Univ. Microfilms Order No. 7811687

Several conspicuous submarine ridges were noted in the abyssal floor of the pre-Mesozoic portions of the Pacific and Atlantic Oceans. The submarine ridges are covered commonly by the conspicuous cyclic sequences of calcareous sediments and siliceous sediments. The carbonate silicate cyclic sequences of chalk, chert or chalk, and clay on the two ridges from the western North Pacific and eastern North Atlantic were investigated petrologically and geochemically in order to clarify the mechanisms of cyclic sedimentation. The two different types of deep sea cherts are suggested: (1) stratigraphically deposited nodular cherts; and (2) tectonically deposited radiolarian mudstone. The chalk chert cycles are representative of the sedimentation environments on the crest of seamounts due to the influence of the fluctuating carbonate compensation depths, also are identifiable in the deep trench basin. Dissert. Abstr.

**N78-31478*+** National Aeronautics and Space Administration, Washington, D. C.
**EARTH RESOURCES: A CONTINUING BIBLIOGRAPHY WITH INDEXES, ISSUE 18**
Aug. 1978 114 p refs
(NASA-SP-7041(18)) Avail: NTIS HC E05 CSCL 05B

This bibliography lists 434 reports, articles, and other documents introduced into the NASA scientific and technical information system between April 1 and June 30, 1978. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis. Author

**N78-31479*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**INPE LANDSAT SYSTEM**
Nelson deJesusParada, Principal Investigator, Marcio Nogueira Barbosa, and Sergio de Paula Pereira Apr. 1977 16 p Presented at LANDSAT Ground Station Operations Working Ground Meeting, 12-14 Apr. 1977 Sponsored by NASA ERTS
(E78-10180; NASA-CR-157370; INPE-1008-RRE/031) Avail: NTIS HC A02/MF A01 CSCL 05B

There are no author identified significant results in this report.

**N78-31480*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**STUDY OF GEOMETRIC DISTORTIONS OF LANDSAT IMAGES**
Nelson DeJesusParada, Principal Investigator, Wilson Custodio C. Dasilva, Jose Carlos Maia, and Luis Danilo Damasceno Ferreira Jun. 1978 61 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA ERTS
(E78-10181; NASA-CR-157371; INPE-1286-PE/140) Avail: NTIS HC A04/MF A01 CSCL 05B

There are no author identified significant results in this report.

**N78-31481*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**AUTOMATIC CLASSIFICATION OF REFORESTED PINUS SPP AND EUCALYPTUS SPP IN MOGI-GUACU, SP, BRAZIL, USING LANDSAT DATA**
Nelson deJesusParada, Principal Investigator, Y. E. Shimabukuro, P. E. Hernandez, N. F. Koffler, and S. C. Chen Apr. 1978 15 p refs Presented at 12th Intern. Symp. of Remote Sensing of Environment, Malina, Philippines, Apr. 1978 Sponsored by NASA ERTS
(E78-10182; NASA-CR-157372; INPE-1223-PE/125) Avail: NTIS HC A02/MF A01 CSCL 02F

The author has identified the following significant results. Single date LANDSAT CCTs were processed, by Image-100 to classify Pinus and Eucalyptus species and their age groups. The study area Mogi-Guacu was located in the humid subtropical climate zone of Sao Paulo. The study was divided into ten preliminary classes and featured selection algorithms were used to calculate Bhattacharyya distance between all possible pairs of these classes in the four available channels. Classes having B-distance values less than 1.30 were grouped in four classes: (1) class PE - P. elliottii, (2) class PO - Pinus species other than P. elliotii, (3) class EY - Eucalyptus spp. under two years, and (4) class EO - Eucalyptus spp. more than two years old. The percentages of correct classification ranged from 70.9% to 94.12%. Comparisons of acreage estimated from the Image-100 with ground truth data showed agreement. The Image-100 percent recognition values for the above four classes were 91.62%, 87.80%, 89.89%, and 103.30%, respectively.

**N78-31482*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**LANDSAT (MSS): IMAGE DEMOGRAPHIC ESTIMATIONS**
Nelson deJesusParada, Principal Investigator and Celina Foresti Nov. 1977 35 p refs Presented at Simposio Internacional de Percepcion Remota Applicada a Demografia y Uso Actual de Tierra, Lapaz, Bolivia, 28-30 Nov. Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(E78-10183; NASA-CR-157373; INPE-1151-PE/103) Avail: NTIS HC A03/MF A01 CSCL 05K

The author has identified the following significant results. Two sets of urban test sites, one with 35 cities and one with 70 cities, were selected in the State, Sao Paulo. A high degree of colinearity (0.96) was found between urban and areal measurements taken from aerial photographs and LANDSAT MSS imagery. High coefficients were observed when census data were regressed against aerial information (0.95) and LANDSAT data (0.92). The validity of population estimations was tested by regressing three urban variables, against three classes of cities. Results supported the effectiveness of LANDSAT to estimate large city populations with diminishing effectiveness as urban areas decrease in size.

**N78-31483*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**INPE'S CROP SURVEY PROGRAM USING COMBINED LANDSAT AND AIRCRAFT DATA**
Nelson deJesusParada, Principal Investigator, Getulio Teixeira Batista, Antonio Tebaldi Tardin, Rene Antonio Novaes, Francisco Jose Mendonca, David Chung Liang Lee, and Sherry Chou Chen Jun. 1978 27 p refs Sponsored by NASA ERTS

(E78-10184; NASA-CR-157374; INPE-1289-NTE/124) Avail: NTIS HC A03/MF A01 CSCL 02C

There are no author-identified significant results in this report.

**N78-31484*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**GEOLOGICAL MAPPING OF REGIONAL DRAINAGE NETWORK IN BRAZIL USING LANDSAT IMAGES**

Nelson deJesusParada, Principal Investigator and Tania Maria Sausen Jun. 1978 55 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA ERTS

(E78-10185; NASA-CR-157375; INPE-1279-NTE/122) Avail: NTIS HC A04/MF A01 CSCL 08H

There are no author-identified significant results in this report.

**N78-31485*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**USE OF LANDSAT DATA TO IDENTIFY AND EVALUATE AREAS OF SUGAR CANE**

Nelson deJesusParada, Principal Investigator, Getulio Teixeira Batista, Franciso Jose Mendonca, David Chung Liango Lee, Antonio Tebaldi Tardin, Sherry Chou Chen, and Rene Antonio Novaes Apr. 1978 30 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS

(E78-10186; NASA-CR-157376; INPE-1228-NTE/116) Avail: NTIS HC A03/MF A01 CSCL 02C

There are no author-identified significant results in this report.

**N78-31486*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**EVALUATION OF ORBITAL IMAGES AS A BASIS FOR LAND UTILIZATION**

Nelson deJesusParada, Principal Investigator, Mario Valerio Filho, Nilton Tocicazu Higa, and Vitor CelsodeCarvalho Jul. 1977 38 p refs In PORTUGUESE; ENGLISH summary ERTS

(E78-10187; NASA-CR-157377; INPE-1054-NTE/091) Avail: NTIS HC A03/MF A01 CSCL 05B

There are no author-identified significant results in this report.

**N78-31487*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**SURFACE HYDRODYNAMICAL MODELS THROUGH SYNOPTIC INTERPRETATION OF LANDSAT MSS IMAGES IN LAGOONAL AND COASTAL WATERS**

Nelson deJesusParada, Principal Investigator and Renato Herz Apr. 1977 16 p refs Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS

(E78-10188; NASA-CR-157378; INPE-1013-NTE/083) Avail: NTIS HC A02/MF A01 CSCL 08H

There are no author-identified significant results in this report.

**N78-31488*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**USE OF LANDSAT IMAGERY FOR SOIL SURVEY**

Nelson deJesusParada, Principal Investigator, Mario Valerio Filho, Nilton Tocicazu Higa, and Vitor CelsodeCarvalho Apr. 1977 24 p refs Sponsored by NASA ERTS

(E78-10189; NASA-CR-157379; INPE-1012-NTE/082) Avail: NTIS HC A02/MF A01 CSCL 08M

The author has identified the following significant results. The MSS channels 6 and 7 were considered the best to study the relative tonality of different spectral responses of soils, while channels 5 and 7 were best for natural vegetation, drainage patterns, and land use. Frequency ratio was the recommended index for use when analyzing a drainage pattern quantitatively.

**N78-31489*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**TOPOGRAPHIC STUDIES THROUGH TEXTURE IMAGE ANALYSIS OF LANDSAT DATA**

Nelson deJesusParada, Principal Investigator, Armando Pacheco dosSantos, and Evlyn Marcia Leao de Moraes Novo Apr. 1977 24 p refs Sponsored by NASA ERTS

(E78-10190; NASA-CR-157380; INPE-1011-NTE/081) Avail: NTIS HC A02/MF A01 CSCL 08B

There are no author-identified significant results in this report.

**N78-31490*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**COLLECTED SUMMARIES OF WORKS DEALING WITH THE APPLICATION OF LANDSAT IMAGERY IN THE SURVEY OF MINERAL RESOURCES**

Nelson deJesusParada, Principal Investigator Apr. 1977 25 p Sponsored by NASA ERTS

(E78-10191; NASA-CR-157381; INPE-1010-NTE/080) Avail: NTIS HC A02/MF A01 CSCL 08G

There are no author-identified significant results in this report.

**N78-31491*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**USE OF LANDSAT DATA TO MONITOR PASTURE PROJECT IN AMAZONIA**

Nelson deJesusParada, Principal Investigator, Armando Pacheco dosSantos, and Evlyn Marcia Leao de Moraes Novo Apr. 1977 17 p refs Sponsored by NASA ERTS

(E78-10192; NASA-CR-157382; INPE-1009-NTE/079) Avail: NTIS HC A02/MF A01 CSCL 02C

The author has identified the following significant results. No differences were found between acreage evaluation by visual and automatic interpretation of LANDSAT images. It was necessary to interpret both channels 5 and 7 to exactly outline the deforested areas. Channel 7 was necessary for the identification of deforested areas in the presence of recently grown natural vegetation, and channel 5 was necessary to identify the deforested areas in the cerrado regions. Automatic interpretation permitted the discrimination between areas with predominant grass coverage and recently grown natural vegetation.

**N78-31492*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**ASSESSMENT OF THE DAMAGE CAUSED BY THE FROST OF 1975 TO COFFEE AND WHEAT CROPS IN THE NORTHWEST OF THE STATE OF PARANA USING LANDSAT IMAGES WITH AUTOMATIC CLASSIFICATION**

Nelson deJesusParada, Principal Investigator, Antonio Tebaldi Tardin, Carlos Vicente Barbieri Palestino, and Claudio Roland Sonnenburg Mar. 1977 15 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS

(E78-10193; NASA-CR-157383; INPE-1007-NTE/078) Avail: NTIS HC A02/MF A01 CSCL 02C

There are no author-identified significant results in this report.

**N78-31493*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**GEOLOGIC APPLICATION OF THERMAL INERTIA IMAGING USING HCMM DATA Quarterly Report, Apr. - Jun. 1978**

Anne B. Kahle and Helen N. Paley, Principal Investigators Aug. 1978 4 p ERTS

(Contract NAS7-100)

(E78-10195; NASA-CR-157385; HCM-028) Avail: NTIS HC A02/MF A01 CSCL 08G

There are no author-identified significant results in this report.

**N78-31494*#** Agricultural Research Service, Phoenix, Ariz.

**HEAT CAPACITY MAPPING MISSION Quarterly Progress Report, 1 May - 31 Jul. 1978**

Ray D. Jackson, Principal Investigator 31 Jul. 1978 3 p ERTS

(NASA Order S-40255-B)

(E78-10196; NASA-CR-157386) Avail: NTIS HC A02/MF A01 CSCL 02C

There are no author-identified significant results in this report.

**N78-31495*#** Central Treaty Organization, Ankara (Turkey).
**REGIONAL INVESTIGATIONS OF TECTONIC AND IGNEOUS GEOLOGY, IRAN, PAKISTAN, AND TURKEY Final Report, 1974 - 1978**
May 1978 56 p refs Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(E78-10197; NASA-CR-157387; Rept-28410) Avail: NTIS HC A04/MF A01 CSCL 08G

The author has identified the following significant results. An extension of the trace of the Chaman-Nushki fault was detected and delineated for 42 km, as was the Ornach-Nal fault for 170 km. Two structural intersections responsible for restricted movements in particular segments of the Chaman-Nushki fault were detected and interpreted. The newest and youngest fault named the Quetta-Mustung-Surab system was delineated for 580 km. The igneous complex of the Lasbela area was interpreted and differentiation was made between ultramafic complex, mafic complex, and basaltic lava flows. One oblong feature was also found which was interpreted as a porphyritic basalt plug.

**N78-31496*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**PROCEDURES FOR GATHERING GROUND TRUTH INFORMATION FOR A SUPERVISED APPROACH TO A COMPUTER IMPLEMENTED LAND COVER CLASSIFICATION OF LANDSAT ACQUIRED MULTISPECTRAL SCANNER DATA**
Armond T. Joyce, Principal Investigator Mar. 1977 83 p refs EREP
(E78-10198; NASA-TM-79742; Rept-163) Avail: NTIS HC A05/MF A01 CSCL 05B

There are no author-identified significant results in this report.

**N78-31497*#** Commission of the European Communities, Ispra (Italy).
**AGRESTE PROJECT: AGRICULTURAL RESOURCES INVESTIGATIONS IN NORTHERN ITALY AND SOUTHERN FRANCE Final Report**
A. Berg, Principal Investigator, G. Flouzat, and S. Galli DeParatesi Jun. 1978 176 p refs Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(E78-10199; NASA-CR-157388) Avail: NTIS HC A09/MF A01 CSCL 02C

The author has identified the following significant results. Recognition of rice varieties at the flowering stage by using airborne scanner data at low altitude (1500 m) seems to be feasible. The accuracies obtained on a reduced test area (3 sq km) range from 65% to 83%. Variations of a single cultural factor, such as nitrogen fertilization, induce variations of the total rice biomass at harvest, which can be correlated closely to the values of the reflectance ratio at earing. When grain production is correlated to total biomass, prediction of yield can be achieved based on reflectance data measured two months before harvest.

**N78-31498*#** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
**ANALYTICAL TECHNIQUES FOR THE STUDY OF SOME PARAMETERS OF MULTISPECTRAL SCANNER SYSTEMS FOR REMOTE SENSING**
E. R. Wiswell and George R. Cooper, Principal Investigators Jun. 1978 195 p refs EREP
(Contract NAS9-15466)
(E78-10200; NASA-CR-151827; LARS-TR-061778; EE-TR-78-28) Avail: NTIS HC A09/MF A01 CSCL 05B

The author has identified the following significant results. The concept of average mutual information in the received spectral random process about the spectral scene was developed. Techniques amenable to implementation on a digital computer were also developed to make the required average mutual information calculations. These techniques required identification of models for the spectral response process of scenes. Stochastic modeling techniques were adapted for use. These techniques were demonstrated on empirical data from wheat and vegetation scenes.

**N78-31499*#** National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
**ATLAS OF SELECTED CROP SPECTRA, IMPERIAL VALLEY, CALIFORNIA**
Stephen G. Ungar, Principal Investigator, William Collins (Columbia Univ.), Jerry C. Coiner (Columbia Univ.), Dwight Egbert (General Telephone and Electronics), Richard Kiang (General Telephone and Electronics), Tina Cary (Columbia Univ.), Peter Coulter (General Telephone and Electronics), Nurit Landau (General Telephone and Electronics), Elaine Mathews (Columbia Univ.), Stephen Lytle (Columbia Univ.) et al Jun. 1977 195 p refs ERTS
(Contract NAS5-20749; Grants NsG-5080; NGR-33-008-191; NsG-5014)
(E78-10201; NASA-TM-79743) Avail: NTIS HC A09/MF A01 CSCL 02C

There are no author-identified significant results in this report.

**N78-31500*#** Lockheed Electronics Co., Houston, Tex. Systems and Services Div.
**NATIONWIDE FORESTRY APPLICATIONS PROGRAM: PROCEDURE 1 APPLICABILITY TO RANGELAND CLASSIFICATION Final Report**
C. A. Reeves, Principal Investigator Jun. 1978 52 p refs EREP
(Contract NAS9-15200)
(E78-10202; NASA-CR-151809; LEC-12174; D-63-1737-5335-02) Avail: NTIS HC A04/MF A01 CSCL 08F

The author has identified the following significant results. An assumption that short prairie grass and salt grass could be differentiated on aircraft photographs was inaccurate for the Weld County site. However, rangeland could be differentiated using procedure 1 from LACIE. Estimates derived from either random or systematic sampling were satisfactory. Level 1 features were separated and mapped, and proportions were estimated with accompanying confidence statements.

**N78-31501*#** Lockheed Electronics Co., Houston, Tex. Systems and Services Div.
**NATIONWIDE FORESTRY APPLICATIONS PROGRAM: TEN-ECOSYSTEM STUDY (TES) SITE 5 REPORT, KERSHAW COUNTY, SOUTH CAROLINA, REPORT 4**
R. D. Dillman, Principal Investigator Jun. 1978 68 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-15200)
(E78-10203; NASA-CR-151813; LEC-11863) Avail: NTIS HC A04/MF A01 CSCL 13B

The author has identified the following significant results. The Kershaw County site, South Carolina, was selected to be representative of both the oak-pine ecosystem and the southeastern pine ecosystem. The following processing results have concluded that: (1) early spring LANDSAT data provide the best contrast between forest features; (2) level 2 forest features (softwood, hardwood, grassland, and water) can be classified with an accuracy of 70% + or - 5.7% at the 90% confidence level; (3) level 3 species classification was inconclusive; (4) temporal data did not provide a significant increase in classification accuracy of level 2 features, over single date classification to warrant the additional processing; and (5) training fields from only 10% of the site can be used to classify the entire site.

**N78-31502*#** Department of Energy, Mines and Resources, Ottawa (Ontario).
**RETRANSMISSION OF HYDROMETRIC DATA IN CANADA Final Report, Jul. 1974 - Mar. 1978**
R. A. Halliday, Principal Investigator and I. A. Reid Apr. 1978 34 p refs Sponsored by NASA ERTS
(E78-10204; NASA-CR-157390) Avail: NTIS HC A03/MF A01 CSCL 08H

The author has identified the following significant results. The LANDSAT program has demonstrated that polar orbiting satellites can be used to relay hydrologic data from any part of Canada to a user without difficulty and at low cost. These data can be used for many operational purposes, the most important

of which were: hydroelectric power plant operation; water supply for municipalities, industries, and irrigation; navigation; flood forecasting; operation of flood control structures and systems; and recreation. A recent economic evaluation of hydrometric data indicated a benefit cost ratio of 9.3 for hydrometric data collection in Canada.

**N78-31503*#** General Electric Co., Philadelphia, Pa. Space Div.
**LANDSAT-1 AND LANDSAT-2 FLIGHT EVALUATION REPORT Progress Report, 23 Oct. 1977 - 23 Jan. 1978**
R. E. Forster, Principal Investigator 1 Feb. 1978 222 p refs ERTS
(Contract NAS5-21808)
(E78-10205; NASA-CR-156800; DOC-78SDS4202) Avail: NTIS HC A10/MF A01 CSCL 05B

There are no author-identified significant results in this report.

**N78-31504*#** Houston Univ., Tex.
**LINEAR FEATURE SELECTION WITH APPLICATIONS**
H. P. Decell, Jr. and L. F. Guseman, Jr., Principal Investigators (Texas A and M Univ., College Station) Jul. 1978 30 p refs EREP
(Contract NAS9-15543)
(E78-10206; NASA-CR-151820; Rept-70) Avail: NTIS HC A03/MF A01 CSCL 02C

There are no author-identified significant results in this report.

**N78-31505*#** Environmental Research Inst. of Michigan, Ann Arbor.
**ANALYSIS OF SCANNER DATA FOR CROP INVENTORIES Progress Report, 15 Mar. - 14 Jun. 1978**
Richard F. Nalepka, Principal Investigator, Richard J. Kauth, Richard C. Cicone, Peter F. Lambeck, William A. Malila, and John E. Colwell 14 Jun. 1978 130 p refs EREP
(Contract NAS9-15476)
(E78-10207; NASA-CR-151754; ERIM-132400-7-L) Avail: NTIS HC A07/MF A01 CSCL 02C

There are no author-identified significant results in this report.

**N78-31506*#** National Aeronautics and Space Administration, Washington, D. C.
**A SUMMARY OF THE USERS PERSPECTIVE OF LANDSAT-D AND REFERENCE DOCUMENT OF LANDSAT USERS**
A. Donald Goedeke and Alexander J. Tuyahov, Principal Investigator 31 Jan. 1977 330 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(E78-10208; NASA-TM-79744) Avail: NTIS HC A15/MF A01 CSCL 05B

There are no author-identified significant results in this report.

**N78-31507*#** Missouri Dept. of Natural Resources, Rolla.
**REMOTE SENSING APPLICATIONS TO MISSOURI ENVIRONMENTAL RESOURCES INFORMATION SYSTEM Final Report**
Robert E. Myers, Principal Investigator 15 Jan. 1978 114 p ERTS
(Contract NAS8-31766)
(E78-10209; NASA-CR-150726) Avail: NTIS HC A06/MF A01 CSCL 05B

There are no author-identified significant results in this report.

**N78-31508*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**HIGH ALTITUDE PERSPECTIVE**
1978 33 p Original contains color illustrations
(NASA-SP-427) Avail: NTIS MF A01; SOD HC $1.60 CSCL 14E

The capabilities of the NASA Ames Center U-2 aircraft for research or experimental programs are described for such areas as Earth resources inventories; remote sensing data interpretation, electronic sensor research and development; satellite investigative support; stratospheric gas studies; and astronomy and astrophysics. The availability of this aircraft on a cost-reimbursable basis for use in high-altitude investigations that cannot be performed by the private sector is discussed. A.R.H.

**N78-31509*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**THE SKYLAB S191 SPECTROMETER EXPERIMENT: ANALYSIS OF DATA AND THEIR APPLICATIONS TO THE EARTH SCIENCES**
V. R. Wilmarth, D. A. Rainey (Lockheed Electron. Co., Houston, Tex.), and W. R. Johnson (Lockheed Electron. Co., Houston, Tex.) Jul. 1978 89 p refs
(NASA-TM-58208; JSC-13886) Avail: NTIS HC A05/MF A01 CSCL 05B

The data in the visible and near-infrared portions of the spectrum as recorded by identical spectrometers on Skylab and on a helicopter are examined to establish the significance of spectral reflectances from the Earth surface as influenced by water vapor, atmospheric gases, and aerosols. Models of radiation transfer show good agreement of theoretical computations and observed measurements. Author

**N78-31510*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**AN EVALUATION OF THE FIRST FOUR LANDSAT-D THEMATIC MAPPER REFLECTIVE SENSORS FOR MONITORING VEGETATION: A COMPARISON WITH OTHER SATELLITE SENSOR SYSTEMS**
Compton J. Tucker May 1978 53 p refs
(NASA-TM-79617) Avail: NTIS HC A04/MF A01 CSCL 08F

The first four LANDSAT-D thematic mapper sensors were evaluated and compared to: the return beam vidicon (RBV) and multispectral scanners (MSS) sensors from LANDSATS 1, 2, and 3; Colvocoresses' proposed 'operational LANDSAT' three band system; and the French SPOT three band system using simulation/intergration techniques and in situ collected spectral reflectance data. Sensors were evaluated by their ability to discriminate vegetation biomass, chlorophyll concentration, and leaf water content. The thematic mapper and SPOT bands were found to be superior in a spectral resolution context to the other three sensor systems for vegetational applications. Significant improvements are expected for most vegetational analyses from LANDSAT-D thematic mapper and SPOT imagery over MSS and RBV imagery. Author

**N78-31511*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**A STUDY OF ALTERATION ASSOCIATED WITH URANIUM OCCURRENCES IN SANDSTONE AND ITS DETECTION BY REMOTE SENSING METHODS, VOLUME 1**
James E. Conel, M. J. Abrams, and A. F. H. Goetz 1 Aug. 1978 261 p refs Prepared for DOE
(Contract NAS7-100)
(NASA-CR-157600; JPL-Pub-78-66-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 08G

The anomalous coloration of altered rocks associated with tabular uranium occurrences in the San Raphael Swell, Utah, and remnants of roll-front type deposits in the Powder River Basin, Wyoming was studied. Field and Laboratory spectral reflectance studies on these uranium deposits or occurrences were carried out and supplemented with mineralogical and chemical analyses to determine the origin of spectral features observed. The principal alteration products are geothite/limonite (Utah deposits) and geothite/limonite and hematite (Wyoming deposits). The principal clay mineral present in the deposits is montomorillonite. Statistical analysis of the field data was performed using a stepwise linear discriminant function analysis computer program that determines which combinations of input wavelength bands provide best separation of specified groupings of data. Altered and unaltered rocks could be repeated with 95% accuracy using spectral data including all wavelength bands. Of the satellite-simulated wavelength region tests, LANDSAT D bands gave the best classification accuracy. A.R.H.

**N78-31512*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**A STUDY OF ALTERATION ASSOCIATED WITH URANIUM OCCURRENCES IN SANDSTONE AND ITS DETECTION BY**

**REMOTE SENSING METHODS, VOLUME 2**
James E. Conel, Michael J. Abrams, and A. F. H. Goetz 1 Aug. 1978 139 p refs Prepared for DOE
(Contract NAS7-100)
(NASA-CR-157601; JPL-Pub-78-66-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 08G

This document contains tabular and graphic data for volume 1. A.R.H.

**N78-31513#** Army Cold Regions Research and Engineering Lab., Hanover, N. H.
**COMPUTER PROCESSING OF LANDSAT DIGITAL DATA AND SENSOR INTERFACE DEVELOPMENT FOR USE IN NEW ENGLAND RESERVOIR MANAGEMENT**
Carolyn J. Merry and Harlan L. McKim Apr. 1978 68 p refs (AD-A055762; CRREL-SR-78-6) Avail: NTIS HC A04/MF A01 CSCL 08/6

A preliminary analysis of LANDSAT digital data using the NASA GISS computer algorithms for an 11 February scene of the upper St. John River Basin, Maine, showed that the total radiance of pixels contained in three snow courses varied from 5.34 to 7.74 mW/sq cm sr for a water equivalent of approximately 24.1 cm (9.5 in.) of water. This correlation between radiance values and water equivalent of the snowpack still needs to be tested. A multispectral signature was developed with an accuracy of 75% for a wetlands category in the Merrimack River estuary. Low-water reservoir and flood water stages were mapped from grayscale printouts of MSS band 7 for 27 October 1972 and 7 July 1973, respectively, for the Franklin Falls reservoir area, New Hampshire. Two snow pillow transducer systems for measuring the water equivalent of the snowpack in northern Maine were interfaced and field tested. Temperature data from the surface to a depth of 30 m (100 ft) were transmitted through the LANDSAT DCS. Also, a tensiometer/transducer system to measure moisture tension and soil volumetric moisture content was successfully interfaced to the LANDSAT DCS. GRA

**N78-31514#** Tennessee Univ., Knoxville.
**DYNAMICS OF THE RECOVERY OF DAMAGED TUNDRA VEGETATION Annual Progress Report**
Clifford C. Amundsen 17 Mar. 1978 8 p refs
(Contract EY-76-S-05-4180)
(ORO-4180-7) Avail: NTIS HC A02/MF A01

Continuing programs on the patterns and processes of disturbed landscape tundra revegetation, the natural revegetation by Elymus mollis Trin., the native dunegrass, in the Aleutian ecosystem was studied. This species is the dominant member of the beach and dune community where it forms dense stands of high biomass. The species are observed, through years of research, colonizing disturbed areas inland. These disturbances may be the bare surfaces of solifluction terraces or they may result from vegetation removal and scarring as the result of man's activities. The surprising aspect of dunegrass colonization on such areas is the presumed depauperate nutritional supply and harsh climate the species encounters. Considering the success of this grass in natural colonization, it is suggested that with careful management, Wlymus mollis could be shown to be useful in revegetation programs in the Aleutians. ERA

**N78-31515#** Humboldt State Coll., Arcata, Calif. School of Natural Resources.
**REMEASUREMENT OF PERMANENT VEGETATION PLOTS IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK, TENNESSEE, USA, AND THE IMPLICATIONS OF CLIMATIC CHANGE ON VEGETATION**
Rudolf W. Becking and Jerry S. Olson (ORNL, Tenn.) Mar. 1978 117 p refs
(Contract W-7405-eng-26)
(ORNL-TM-6083; Publ-1111) Avail: NTIS HC A06/MF A01

Field work over two summers (1976 and 1977)to relocate, monument and reinventory permanent vegetation plots in the Great Smoky Mountains National Park is summarized. The inventory results are discussed in terms of vegetation changes in high-altitudinal forest ecosystems, in particular the spruce-fir forests, and the factors, climate shift and biotic and abiotic agents, bringing about vegetation change. A second aspect of the report summarizes experience and offers recommendations for establishment of permanent vegetation plots for the purpose of providing a monitoring tool with which to measure long-term ecological change. ERA

**N78-31516#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme.
**THE COVERAGE FIELD OF EARTH OBSERVATION SATELLITES AT THE EARTH SURFACE. DESCRIPTION OF THE COMPUTER PROGRAM COFI [DAS UEBERDECKUNGSFELD ERDBEOBACHTENDER SATELLITEN AUF DER ERDOBERFLAECHE. BESCHREIBUNG DES RECHNERPROGRAMS COFI]**
E. Fritz Jochim and W. Pawlik 1977 66 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-487)
(DLR-IB-552-77/40) Avail: NTIS HC A04/MF A01

FORTRAN 4 a computer program which generates a geographical coordinates or latitude-mean solar time printer plot of coverage field and coverage frequency of an earth observation satellite is described. Any nadir angle and half width of the perpendicular to the trajectory scanning sensor may be selected. Repeatedly covered regions are characterized by different output characters. The presentation may be limited on certain local solar time intervals. Author (ESA)

**N78-31517#** General Accounting Office, Washington, D. C. Procurement and Systems Acquisition Div.
**LANDSAT POLICY ISSUES STILL UNRESOLVED**
17 Apr. 1978 34 p
(PB-279701/7; PSAD-78-58) Avail: NTIS HC A03/MF A01 CSCL 08B

The need to keep the Congress informed on the goals and results of studies relating to satellite-based, remote-sensing policy issues is discussed. GRA

**N78-31518#** South Dakota State Univ., Brookings. Dept. of Physics.
**APPLICATION OF HEAT-FLOW TEMPERATURE MODEL FOR REMOTELY ASSESSING NEAR SURFACE SOIL MOISTURE BY THERMOGRAPHY Final Report**
Jerald A. Tunheim Nov. 1977 50 p refs
(Contract DI-14-31-0001-6043)
(PB-279616/7; W78-05932) Avail: NTIS HC A03/MF A01 CSCL 08H

Detection and mapping of near-surface ground water by the use of remote sensed thermal emittance data (thermography) are reported. The specific focus was on detection of saline seeps in their preemergence stages. Soil temperature profiles, water table depths, and other pertinent data were collected in two potential seep areas. These data were related to thermal emittance acquired during three aircraft flights and results were used to modify a theoretical model. Author

**N78-31519#** Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
**FUNDAMENTAL STOCHASTIC MODELS OF THE TRANSPORT OF WATER AND SOLUTES THROUGH SATURATED AND UNSATURATED POROUS MEDIA Final Report**
V. K. Gupta, G. Sposito, and R. N. Bhattacharya Dec. 1977 49 p refs
(Contract DI-14-34-0001-7136)
(PB-279772/8; W78-06064) Avail: NTIS HC A03/MF A01 CSCL 08H

The theories that were employed to derive the macroscopic partial differential equations that describe solute transport through porous media are reviewed critically. These theories are grouped into three general classes: (1) approaches based in fluid mechanics; (2) approaches based in the theory of Markov processes; and (3) approached based in a formal analogy between statistical thermodynamics and hydrodynamic dispersion. GRA

**N78-31520#** Montana State Highway Dept., Helena. Water Resources Research Center.
**USING TOPOGRAPHIC CHARACTERISTICS TO PREDICT TOTAL SOLUTE CONCENTRATIONS IN STREAMS DRAINING SMALL FORESTED WATERSHEDS IN WESTERN MONTANA Final Report**

G. Thomas Foggin, III and Lawrence K. Forcier Sep. 1977 46 p refs
(PB-280578/6; MUJWRRC-88) Avail: NTIS HC A03/MF A01 CSCL 08H

Fifty local headwater streams draining undisturbed forested basins underlain by quartzites and argillites of the Precambrian Belt Supergroup in Western Montana were sampled during the 1976 spring runoff period. Total solute concentration in these streams was determined to be primarily related to the composition of the basin's parent material and secondarily to its morphometric character. Seasonal variation in total solute concentration was related to the degree of dilution a stream experienced during the period of high discharge. Constants for total solute concentration and seasonal variation for the sample streams were predicted from regression equations. GRA

**N78-31521#** Metropolitan Washington Council of Governments, D. C.
**A DEMONSTRATION OF AREAWIDE WATER RESOURCES PLANNING Final Report**
Charles S. Spooner, John Promise, and Philip H. Graham Apr. 1978 212 p refs
(Grants EPA-S-802149; EPA-16110-FEY)
(PB-280750/1; EPA-600/5-78-006a) Avail: NTIS HC A10/MF A01 CSCL 13B

A comprehensive analytical tool for use in areawide water resources management planning is described. The physical simulation portion was formed by linking component computer models which test alternative future community development patterns by small area, estimate water demands by usage categories, calculate sewage flows based on water demands and add infiltration/inflow, simulate stormwater runoff, test application of alternative waste treatment management systems, and simulate the quality response of the region's major water body. Methodologies for assessing the fiscal, social, and environmental impacts of alternatives are included. GRA

**N78-31522#** Kansas Water Resources Research Inst., Manhattan.
**PROBLEMS ASSOCIATED WITH MAINTENANCE OF CHANNEL CAPACITY BELOW FEDERAL RESERVOIRS IN KANSAS Project Report, 1 Jul. 1975 - 30 Jun. 1977**
Tai Huang and Ernest C. Pogge Feb. 1978 118 p refs
(Contract DI-14-34-0001-6017)
(PB-280560/4; Contrib-195; W78-06580;
OWRT-A-075-KAN(1)) Avail: NTIS HC A06/MF A01 CSCL 08H

The theories and concepts of fluvial morphology and free-surface flow are utilized to develop conceptual models relating to the changes and trends of changes resulting when the natural flow regime of a stream is altered through the construction and operation of a large resevoir. A series of case studies for stream reaches below existing reservoirs are performed utilizing the limited amount of data that was available. A channel degradation model is developed and tested on Wakarusa River below Clinton Dam near Lawrence, Kansas. GRA

**N78-31523#** Illinois Univ. at Urbana-Champaign, Urbana. Water Resources Center.
**CATALOG OF WATER RESOURCES RESEARCH IN ILLINOIS**
Patti Welch Jul. 1977 113 p refs Sponsored by the Illinois Inst. for Environmental Quality
(PB-280561/2; UILU-WRC-77-0007; W78-06412; Rept-7)
Avail: NTIS HC A06/MF A01 CSCL 13B

One of the responsibilities of the Water Resources Center is to collect and compile information on water resources research projects being conducted by institutions and agencies in Illinois. That information, needed to avoid duplication of research efforts, is published in this catalog. The research projects are listed by the investigating agency. Most of the projects were considered active as to June 1977. A subject index is presented in the appendix. Researchers and users of research results who have a need for more information about specific projects should direct their inquiries to the principal investigator at the agency or institution listed. GRA

**N78-31524#** Massachusetts Univ., Amherst. Water Resources Research Center.
**PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING: A CASE STUDY AND LITERATURE REVIEW Final Report**
Madge Ertel and Stuart G. Koch Jul. 1977 62 p refs
(Contract DI-14-34-0001-6086)
(PB-280968/9; Publ-89; Completion-FY-77-10; W78-06809)
Avail: NTIS HC A04/MF A01 CSCL 13B

The findings of a survey to determine what modifications in attitudes toward the advisory process and the planning objectives of the Connecticut River Basin Program had occurred since a similar survey was conducted are presented. A review and assessment of significant literature on the theory and practice of public participation in water resources planning is given. GRA

## 44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

**N78-31525*** National Aeronautics and Space Administration. Pasadena Office, Calif.
**SOLAR POND Patent**
Charles G. Miller (JPL) and James B. Stephens, inventors (to NASA) (JPL) Issued 30 May 1978 9 p Filed 30 Jun. 1977 Supersedes N77-28584 (15 - 19, p 2550) Continuation of abandoned US Patent Appl. SN-590975, filed 27 Jun. 1975 sponsored by NASA
(NASA-Case-NPO-13581-2; US-Patent-4,091,800;
US-Patent-Appl-SN-811815; US-Patent-Class-126-271;
US-Patent-Class-237-1A; US-Patent-Appl-SN-590975) Avail: US Patent Office CSCL 10C

Shallow pools of liquid to collect low-temperature solar generated thermal energy are described. Narrow elongated trenches, grouped together over a wide area, are lined with a heat-absorbing black liner. The heat-absorbing liquid is kept separate from the thermal energy removing fluid by means such as clear polyethylene material. The covering for the pond may be a fluid or solid. If the covering is a fluid, fire fighting foam, continuously generated, or siloons are used to keep the surface covering clean and insulated. If the thermal energy removing fluid is a gas, a fluid insulation layer contained in a flat polyethlene tubing is used to cover the pond. The side of the tube directed towards the sun is treated to block out ultraviolet radiation and trap in infrared radiation.
Official Gazette of the U.S. Patent Office

**N78-31526*** National Aeronautics and Space Administration. Pasadena Office, Calif.
**NON-TRACKING SOLAR ENERGY COLLECTOR SYSTEM Patent**
M. Kudret Selcuk, inventor (to NASA) (JPL) Issued 30 May 1978 7 p Filed 3 Feb. 1977 Supersedes N77-19579 (15 - 10 p 13358) Sponsored by NASA
(NASA-Case-NPO-13813-1; NASA-Case-NPO-13914-1;
US-Patent-4,091,798; US-Patent-Appl-SN-765139;
US-Patent-Class-126-271; US-Patent-Class-126-270;
US-Patent-Class-350-299) Avail: US Patent Office CSCL 10A

A solar energy collector system characterized by an improved concentrator for directing incident rays of solar energy on parallel vacuum-jacketed receivers or absorbers is described. Numerous individually mounted reflector modules of a common asymmetrical triangular cross-sectional configuration are supported for independent reorientation. Asymmetric vee-trough concentrators are defined. Official Gazette of the U.S. Patent Office

**N78-31527*** National Aeronautics and Space Administration. Pasadena Office, Calif.

**COAL DESULFURIZATION PROCESS Patent**
George C. Hsu (JPL), George R. Gavalas (JPL), Partha S. Ganguli (JPL), and Sarkis H. Kalfayan (JPL) Issued 28 Mar. 1978 7 p Sponsored by NASA
(NASA-Case-NPO-13937-1; US-Patent-4,081,250; US-Patent-Appl-SN-718137; US-Patent-Class-44-1R; US-Patent-Class-44-2; US-Patent-Class-201-17) Avail: US Patent Office CSCL 07D

A method for chlorinolysis of coal is an organic solvent at a moderate temperautre and atmospheric pressure has been proven to be effective in removing sulfur, particularly the organic sulfur, from coal. Chlorine gas is bubbled through a slurry of moist coal in chlorinated solvent. The chlorinated coal is separated, hydrolyzed and the dechlorinated. Preliminary results of treating a high sulfutr (4.77%S) bituminous coal show that up to 70% organic sulfur, 90% hyritic sulfur and 76% total sulfur can be removed. The treated coal is dechlorinated by heating at 500 C. The presence of moisture helps to remove organic sulfur. Official Gazette of the U.S. Patent Office

**N78-31528** Pennsylvania State Univ., University Park.
**TRANSIENT BEHAVIOR OF SOLID SENSIBLE HEAT THERMAL ENERGY STORAGE UNITS Ph.D. Thesis**
Janos Szego 1978 214 p
Avail: Univ. Microfilms Order No. 78-12080

The geometrical configurations analized were the flat-slab and the hollow-cylinder. Both geometries were examined under single fluids and two fluids operation, analytically and experimentally. The energy equation(s) for the fluid(s), coupled to the two dimensional transient conduction equation for the storage material, was solved numerically using finite difference techniques. The parameters that characterize the transient of these units were identified and presented in graphical and tabular form. The results presented can be useful to predict the transient response of a heat storage unit experiencing an arbitrary fine varying, fluid inlet temperature, by employing superposition techniques. The complete finite difference programs that were developed are able to handle such situations as dissimilar storage materials, irregular geometrical boundaries and time varying inlet fluid temperatures and/or mass flow rates. Dissert. Abstr.

**N78-31529** Ohio State Univ., Columbus.
**A VARIABLE INERTIA FLYWHEEL AS AN ENERGY STORAGE SYSTEM Ph.D. Thesis**
David Gordon Ullman 1978 216 p
Avail: Univ. Microfilms Order No. 7812395

A variable inertia flywheel (VIF) system was designed and fabricated to verify theoretical predictions and to evaluate the basic operating characteristics of the concept. A fully controllable VIF, full control over the moment of inertia irrespective of the VIF state, is not practical as the efficiency obtained can be no better than a fixed inertia flywheel with an infinitely variable ratio transmission. However, a VIF with a fixed power recirculation results in a flywheel with a unique torque/angular rate characteristic. A VIF can theoretically be formed such that the torque is related to any function of angular rate. Dissert. Abstr.

**N78-31530*+** National Aeronautics and Space Administration, Washington, D. C.
**ENERGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, ISSUE 17**
Apr. 1978 347 p refs
(NASA-SP-7043(17)) Avail: NTIS HC E05 CSCL 10B

This bibliography lists 1292 reports, articles, and other documents introduced into the NASA scientific and technical information system from January 1, 1978 through March 31, 1978. Author

**N78-31531*#** Alabama Univ., Huntsville. Dept. of Physics.
**MEASUREMENTS OF MATERIAL PROPERTIES FOR SOLAR CELLS Final Report, 7 Feb. 1977 - 6 Mar. 1978**
John G. Castle, Jr. Jul. 1978 34 p refs
(Contract NAS8-32398)
(NASA-CR-150797) Avail: NTIS HC A03/MF A01 CSCL 10A

Measurements on two candidate materials for space flight are reported. The observed optical transmittance of aluminum films vapor deposited on fused quartz showed anomalously high transmittance thru 400 A and 600 A and showed an effective skin depth of 110 A in the latter part of the 1000 A thickness. KAPTON films are shown by their optical transmission spectra to have an energy gap for electron excitation of approximately 2.5 eV, which value depends on the thickness as manufactured. The resistance of KAPTON film to ionizing radiation is described by their optical spectra and their electron spin resonance spectra. Author

**N78-31532*#** Honeywell, Inc., Minneapolis, Minn.
**SOLAR HEATING AND COOLING SYSTEMS DESIGN AND DEVELOPMENT Quarterly Report, 1 Apr. 1977 - 30 Jun. 1977**
Jul. 1977 88 p Prepared for DOE
(Contract NAS8-32093)
(NASA-CR-150770; QR-4) Avail: NTIS HC A05/MF A01 CSCL 10A

The development of twelve prototype solar heating/cooling systems, six heating and six heating and cooling systems, two each for single family, multi-family, and commercial applications, is reported. Schedules and technical discussions, along with illustrations on the progress made from April 1, 1977 through June 30, 1977 are detailed. G.G.

**N78-31533*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**INITIAL TEST RESULTS WITH A SINGLE-CYLINDER RHOMBIC-DRIVE STIRLING ENGINE Final Report**
J. E. Cairelli, L. G. Thieme, and R. J. Walter Jul. 1978 42 p refs
(Contract EC-77-A-31-1040)
(NASA-TM-78919; E-9656; DOE/NASA/1040-78/1) Avail: NTIS HC A03/MF A01 CSCL 10B

A 6 kW (8 hp), single-cylinder, rhombic-drive Stirling engine was restored to operating condition, and preliminary characterization tests run with hydrogen and helium as the working gases. Initial tests show the engine brake specific fuel consumption (BSFC) with hydrogen working gas to be within the range of BSFC observed by the Army at Fort Belvoir, Virginia, in 1966. The minimum system specific fuel consumption (SFC) observed during the initial tests with hydrogen was 669 g/kW hr (1.1 lb/hpx hr), compared with 620 g/kWx hr (1.02 lb/hpx hr) for the Army tests. However, the engine output power for a given mean compression-space pressure was lower than for the Army tests. The observed output power at a working-space pressure of 5 MPa (725 psig) was 3.27 kW (4.39 hp) for the initial tests and 3.80 kW (5.09 hp) for the Army tests. As expected, the engine power with helium was substantially lower than with hydrogen. J.M.S.

**N78-31534*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EFFECT OF INLET TEMPERATURE ON THE PERFORMANCE OF A CATALYTIC REACTOR**
David N. Anderson 1978 21 p refs Presented at the 3d Workshop on Catalytic Combust., Asheville, N. C., 3-4 Oct. 1978; sponsored by EPA
(Contract EC-77-A-31-1040)
(NASA-TM-78977; DOE/NASA/1040-78/3; E-9752) Avail: NTIS HC A02/MF A01 CSCL 10A

A 12 cm diameter by 15 cm long catalytic reactor was tested with No. 2 diesel fuel in a combustion test rig at inlet temperatures of 700, 800, 900, and 1000 K. Other test conditions included pressures of 3 and 6 x 10 to the 5th power Pa, reference velocities of 10, 15, and 20 m/s, and adiabatic combustion temperatures in the range 1100 to 1400 K. The combustion efficiency was calculated from measurements of carbon monoxide and unburned hydrocarbon emissions. Nitrogen oxide emissions and reactor pressure drop were also measured. At a reference velocity of 10 m/s, the CO and unburned hydrocarbons emissions, and, therefore, the combustion efficiency, were independent of inlet temperature. At an inlet temperature of 1000 K, they were independent of reference velocity. Nitrogen oxides emissions resulted from conversion of the small amount (135 ppm) of fuel-bound nitrogen in the fuel. Up to 90 percent conversion was observed with no apparent effect of any of the test variables. For typical gas turbine operating conditions, all three pollutants

were below levels which would permit the most stringent proposed automotive emissions standards to be met. Author

**N78-31535*#** Solar Control Corp., Boulder, Colo.
**SOLAR CONTROL DESIGN PACKAGE**
Aug. 1978 57 p Prepared for DOE
(Contract NAS8-32258)
(NASA-CR-150771) Avail: NTIS HC A04/MF A01 CSCL 10A

Information used in the evaluation of design of Solar Control's solar heating and cooling system controller and the Solarstat is given. Some of the information includes system performance specifications, design data brochures, and detailed design drawings. L.S.

**N78-31536*#** CALMAC Mfg. Co., Englewood, N. J.
**DESIGN AND INSTALLATION PACKAGE FOR THE SUNMAT FLAT PLATE SOLAR COLLECTOR**
Mar. 1978 63 p Prepared for DOE
(Contract NAS8-32253)
(NASA-CR-150741) Avail: NTIS HC A04/MF A01 CSCL 10A

The information used in evaluating the design of a liquid flat plate solar collector is reported. Included in this package are subsystem performance specification, installation, operation and maintenance manuals, collector sizing guides, and detailed drawings of the single-glazed collector. G.G.

**N78-31537*#** Boeing Co., Seattle, Wash.
**APPLICATIONS OF THERMAL ENERGY STORAGE TO PROCESS HEAT STORAGE AND RECOVERY IN THE PAPER AND PULP INDUSTRY Final Report**
J. H. Carr, P. J. Hurley (Weyerhaeuser Co.), and P. J. Martin (SRI Intern. Corp.) Sep. 1978 245 p refs Sponsored by NASA
(Contract EC-77-C-01-5082)
(NASA-CR-159398; CONS/5082-1) Avail: NTIS HC A11/MF A01 CSCL 10A

The transfer of steam production from fossil fuel boilers to waste fuel boilers in a paper and pulp mill powerhouse was studied. Data from specific mills were analyzed, and various TES concepts evaluated for application in the process steam supply system. Constant pressure and variable pressure steam accumulators were found to be the most attractive storage concepts for this application. Performance analyses based on the operation of a mathematical model of the process steam supply system indicate potential substitution of waste wood fuel fuel for 100,000 bbl oil per year per installation with the accumulator TES system. Based on an industry survey of potential TES application, which requires excess base steaming capability, the results from the individual installation were extrapolated to a near-term (1980's) fossil fuel savings in the paper and pulp industry of 3.2 x 1 ,million bbl oil/year. Conceptual designs of mechanical equipment and control systems indicate installed cost estimates of about $560,000 per installation, indicating an after tax return on investment of over 30 percent. G.G.

**N78-31538*#** Solar Engineering and Mfg. Co., Ft. Lauderdale, Fla.
**DESIGN DATA BROCHURE: SOLAR HOT WATER SYSTEM**
Jul. 1978 21 p Prepared for DOE
(Contract NAS8-32247)
(NASA-CR-150699) Avail: NTIS HC A02/MF A01 CSCL 10A

A design calculation is detailed for a single-family residence housing a family of four in a nonspecific geographical area. The solar water heater system is designed to provide 80 gallons of 140 F hot water per day. G.G.

**N78-31539*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GREENBELT COMMUNITY PROJECT: SOLAR ENERGY RETROFIT FOR A MULTI-FAMILY DWELLING**
E. W. Hymowitz, R. J. Hannemann (Hannemann Eng. Serv., Upper Marlboro, Md.), L. L. Millman, and J. E. Pownell Jun. 1978 133 p refs
(NASA-TM-79612) Avail: NTIS HC A07/MF A01 CSCL 10A

A cooperative project was initiated between Goddard Space Flight Center and the nearby community of Greenbelt, Maryland. The purpose was to design, install and operate an experimental solar heating system on a group of four tandem town houses. The system was successfully developed and is operating. A description is given of the design, installation, system operation and performance as well as the important considerations for judging the economic feasibility of solar heating systems. L.S.

**N78-31540*#** Naval Weapons Support Center, Crane, Ind.
**EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS Annual Report**
J. D. Harkness 1 Feb. 1978 285 p
(NASA Order S-53742-AG)
(NASA-CR-156812; WQEC/C-78-1; AR-14) Avail: NTIS HC A13/MF A01 CSCL 10A

The results of life cycle tests of secondary spacecraft cells are summarized. Cells consisted of seven sample classifications ranging from 3.0 to 20 ampere-hours, 1326 nlc nickel cadmium, 183 silver cadmium, and 125 silver zinc sealed cells. Variables examined include load, charge control, and temperature conditions. J.M.S.

**N78-31541*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**JPL ENERGY CONSUMPTION PROGRAM (ECP) DOCUMENTATION: A COMPUTER MODEL SIMULATING HEATING, COOLING AND ENERGY LOADS IN BUILDINGS**
F. L. Lansing, V. W. Chai, D. Lascu, R. Urbenajo, and P. Wong 15 Sep. 1978 239 p refs
(Contract NAS7-100)
(NASA-CR-157599; JPL-PUB-78-76) Avail: NTIS HC A11/MF A01 CSCL 10A

The engineering manual provides a complete companion documentation about the structure of the main program and subroutines, the preparation of input data, the interpretation of output results, access and use of the program, and the detailed description of all the analytic, logical expressions and flow charts used in computations and program structure. A numerical example is provided and solved completely to show the sequence of computations followed. The program is carefully structured to reduce both user's time and costs without sacrificing accuracy. The user would expect a cost of CPU time of approximately $5.00 per building zone excluding printing costs. The accuracy, on the other hand, measured by deviation of simulated consumption from watt-hour meter readings, was found by many simulation tests not to exceed + or - 10 percent margin. G.G.

**N78-31542#** Committee on Science and Technology (U. S. House).
**BRIEFING ON DEPARTMENT OF ENERGY**
Washington GPO 1977 36 p Hearing before the Subcomm. on the Environment and the Atmosphere of the Comm. on Sci. and Technol., 95th Congr., 1st Sess., 4 Nov. 1977
(GPO-20-083) Avail: Subcomm. on the Environment and the Atmosphere

The organization of the Department of Energy is discussed in terms of environmental, safety, and related activities. The functions of the various offices within the structure of Department of Energy are stressed. Other topics discussed include the role that environmental impact plays in awarding contracts and the enforcement of occupational health and safety regulations and environmental protection requirements. J.M.S.

**N78-31543#** Committee on Science and Technology (U. S. House).
**ENVIRONMENTAL CHALLENGES OF THE PRESIDENT'S ENERGY PLAN: IMPLICATIONS FOR RESEARCH AND DEVELOPMENT**
Washington GPO 1977 181 p refs Rept. for Subcomm. on the Environment and the Atmosphere of the Comm. on Sci. and Technol., 95th Congr., 1st Sess., Oct. 1977 Prepared by the Library of Congr., Congressional Res. Service
(GPO-96-834) Avail: SOD HC

An overview of perceived environmental concerns and Federal environmental related-energy research and development is given with emphasis on the environmental implications of the President's Energy Plan. An experimental environmental monitoring program

is suggested to ensure adequate performance of pollution control techniques. J.M.S.

**N78-31544#** TADIRAN Israel Electronics Industries, Ltd., Tel Aviv.
**TADIRAN HIGH ENERGY LITHIUM BATTERIES**
Dec. 1977 55 p refs
(LBR-1501) Avail: NTIS HC A04/MF A01

The electrical and environmental performance of a primary lithium inorganic battery is described as well as its reliability and safety features. The cell consists of a lithium anode, a carbon cathode, and a solution of lithium aluminum chloride in thionyl chloride. The latter serves as an electrolyte carrier for ions and as an active cathodic depolarizer for on catalytic surfaces. The teflon-bonded carbon cathode is the catalytic medium. There is no cathodic reduction of thionyl chloride on the lithium surface due to the high activation energy required for the reduction process and the formation of a thin surface film of LiCl which inhibits its reduction. The battery has more than twenty times the energy of conventional dry cells and over five times the shelf life. Nominal cell voltage is 3.4 volts. A.R.H.

**N78-31545#** Optical Coating Lab., Inc., City of Industry, Calif. Photoelectronics Div.
**HIGH OUTPUT SOLAR CELL WITH MULTILAYER AR COATING Final Report, Aug. 1976 - Aug. 1977**
Peter Iles Wright-Patterson AFB, Ohio AFAPL Nov. 1977 84 p refs
(Contract F33615-76-C-2166; AF Proj. 682J)
(AD-A054226; AFAPL-TR-77-71) Avail: NTIS HC A05/MF A01 CSCL 10/2

During this contract, high efficiency, polished surface, uncoated cells were prepared, and when AR coated with multilayers, achieved AMO cell output in the range 74-80 mW. These cells showed promise for space uses; additional work was identified to make these cells fully compatible with present methods for electrostatically bonding integral covers to cells. Author (GRA)

**N78-31546#** Army Electronics Technology and Devices Lab., Fort Monmouth, N. J.
**ALTERNATE POWER SOURCES SESSION: NUCLEAR BATTERY HYBRID CONFIGURATION STUDY**
Guido Guazzoni 1978 4 p ref Repr. from 27th Ann. Proc. Power Sources Conf., Jun. 1976
(AD-A055182) Avail: NTIS HC A02/MF A01 CSCL 10/2

Power source requirements for worldwide military applications include a need for low level power (milliwatts average power) under conditions for unattended, extended periods of time. The energy content needed in such applications and the requirement for continuous, troublefree operation led to the investigation of the military potential of radioisotope thermoelectric power sources, with specific interest in a hybrid configuration using a sealed nickel-cadmium battery. By using the nuclear particle emission energy of radioactive decay, nuclear battery devices have the highest stored energy density of any other power source. However, the power output is low being related to the emission half-life of the isotope. Attainment of inherently good device power regulation requires a relatively long life isotope. Plutonium-238 (Pu-238), an 86 year half-life alpha (short range) emitter, has become available in practical quantities. It offers a very low emission hazard and, when properly encapsulated in a sintered oxide fuel form, it provides an almost ideal isotopic heat source which is safe to use under all anticipated extremes of heat and shock. Author (GRA)

**N78-31547#** Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
**THERMAL STRATIFICATION ENHANCEMENT FOR SOLAR ENERGY APPLICATIONS Final Report**
R. I. Loerke, M. K. Sharp, H. N. Gari, and R. D. Haberstroh Jul. 1977 80 p refs
(Contract N68305-76-C-0036; ZF57571001)
(AD-A055918; CEL-CR-78.011) Avail: NTIS HC A05/MF A01 CSCL 10/3

A study is presented that shows methods to enhance stratification in liquid storage tanks. The report focuses on the development of a passive inlet distributor which minimizes mixing between incoming and stored fluids at unlike temperatures. Theoretical analyses and scale model tests were performed. Computer simulations were used to compare mixed storage with stratified storage in a solar space heating system. Test results showed that in some cases nearly ideal stratification can be obtained, and the computer simulations indicated that the load carrying capability of a solar system may be increased 5-10% through the use of stratified storage. Author (GRA)

**N78-31548#** Globe-Union, Inc., Milwaukee, Wis.
**DESIGN AND COST STUDY FOR DEVELOPMENT OF LEAD-ACID BATTERIES SUITABLE FOR ELECTRIC VEHICLE PROPULSION Final Report**
C. E. Weinlein 1977 126 p
(Contract W-31-109-eng-38)
(ANL-K-77-3624-1) Avail: NTIS HC A07/MF A01

A design for an improved state-of-the-art (ISOA) battery is proposed. It is believed that this ISOA design is the most efficient design achievable within the constraints of the ISOA battery development program. These constraints include realistic time and financial limitations, and compatibility with existing highspeed production equipment. The ISOA battery is in fact an improved, state-of-the-art lead acid battery for use in an electric vehicle. A durable, light weight polypropylene container and cover complete with single point watering and venting features are incorporated in the ISOA design. A number of materials and process parameters with profound affect on battery performance were chosen after extensive evaluation and cell testing. Development of an advanced lead acid electric vehicle battery involved the evaluation and application of effective forward concepts in the design of the battery. Many weight-saving designs were incorporated. Significant improvements in active material efficiencies and integrity are required. Author (ERA)

**N78-31549#** California Univ., Livermore. Lawrence Livermore Lab.
**HIGH PERFORMANCE METAL/AIR FUEL CELLS. PART 1: GENERAL REVIEW**
J. F. Cooper 15 Aug. 1977 27 p refs
(Contract W-7405-eng-48)
(UCID-17558-Pt-1) Avail: NTIS HC A03/MF A01

Metal/air fuel cells are reviewed in terms of their potential application in electric vehicles. Attention is focused on those metals (light alkali and alkaline earth metals, and aluminum) which, in combination with oxygen, have theoretical energy densities exceeding that of gasoline. Lithium and aluminum yielded 8- and 4 kWh/kg, respectively, in laboratory experimental cells. The slurry Zn/air system achieves 0.85 kWh/kg-Zn in prototype vehicle cells and is reviewed for comparison. The remaining metals appear to be unsuitable for use in aqueous electrolyte fuel cells. The discharge characteristics of lithium, aluminum, and (possibly) calcium/air cells indicate the potential for electric vehicles of the highway performance and minimum range (300 miles) of subcompact automobiles, rapid refueling for unlimited range extension, and the storage in the fuel cell of sufficient metal for ranges in excess of 1000 miles. The energy efficiency of a transportation system using aluminum was estimated using data on the current aluminum production industry. ERA

**N78-31550#** Sandia Labs., Livermore, Calif.
**SOLAR CENTRAL RECEIVER POWER PLANTS**
A. C. Skinrood Sep. 1977 21 p refs Presented at Solar Energy Workshop, Ashkhabad, USSR, Sep. 1977
(Contract EY-76-C-04-0789)
(SAND-77-8510; Conf-770944-1) Avail: NTIS HC A02/MF A01

Prototype heliostats, receivers, and storage subsystems were built and tested as a part of the recently completed two year research and development program for solar central receiver system technology. This technology will serve as the basis for the detailed design and construction of a 10-MW pilot plant in Barstow, California, scheduled for operation in 1981. Successful operation could lead to the construction of a demonstration plant in the mid to late 1980s. ERA

**N78-31551#** Westinghouse Electric Corp., Tampa, Fla.
**DESIGN AND COST STUDY OF A NICKEL-IRON OXIDE BATTERY FOR ELECTRIC VEHICLES. VOLUME 2: PUBLIC REPORT Final Report**

R. E. Vaill 23 Aug. 1977 73 p
(Contract W-7405-eng-38)
(ANL-K-3723-1) Avail: NTIS HC A04/MF A01

A nickel-iron oxide battery design concept is proposed. Development problems were addressed, and the methods of solution, identified. The manufacturing cost of the proposed design is identified for annual production quantities of 1,000, 10,000, and 100,000 25 kWh batteries. Based on the high-volume estimates of material, labor, and capital requirements, a selling price of $60/kWh was found to be attainable. Battery test requirements were identified which will serve to define the performance characteristics of interest to a potential user. A follow-on R and D program plan was developed which combines significant electrode and cell development with demonstrations of performance and potential costs in the form of prototype hardware. ERA

**N78-31552#** Oklahoma Univ., Norman. Office of Research Administration.
**THERMAL AND KINETIC ANALYSIS OF THE PYROLYSIS OF COALS Final Report**
V. V. Hathi and C. M. Sliepcevich Aug. 1977 253 p refs
(EPRI Proj. 368-1)
(EPRI-AF-528) Avail: NTIS HC A12/MF A01

The thermal decomposition (pyrolysis) of nine bituminous coals of the United States was investigated in a nitrogen atmosphere. Weight loss and rate of weight loss were measured at various heating rates. The major devolatilization occurred between 300 C and 700 C with the peaks shifting to higher temperatures at faster heating rates. Kinetic parameters for each heating rate were derived from these measurements by means of a model which has been used successfully to describe the pyrolysis of woods and wildland fuels. Energetic effects during pyrolysis were measured directly up to 727 C on a Perkin-Elmer different scanning calorimeter. The decomposition of bituminous coals is endothermic up to 500 C and exothermic thereafter; the energy of pyrolysis is more exothermic with decreasing heating rates. Quantitative repeatibility of these energetic measurements was less than desired because of baseline shifts arising from condensation of decomposition products on the surfaces of the sample holder. ERA

**N78-31553#** Los Alamos Scientific Lab., N. Mex.
**HOT DRY ROCK, AN ALTERNATE GEOTHERMAL ENERGY RESOURCE: A CHALLENGE FOR INSTRUMENTATION**
B. R. Dennis and E. H. Horton 1978 14 p refs Presented at 24th Intern. Instrumentation Symp., Albuquerque, N. Mex., 1 May 1978
(Contract W-7405-eng-36)
(LA-UR-78-707; Conf-780503-8) Avail: NTIS HC A02/MF A01

The hot dry rock that composes most of the earth's crust has the potential of becoming one of the largest reservoirs of energy economically available in the near future. A technique to demonstrate the technical and economic feasibility of extracting heat from the hot dry rock source is reported that depends upon the connection of two deep boreholes drilled into impermeable precambrian granite where the temperature approaches 200 C. The boreholes are connected by a system of hydraulic-produced fractures. Cold water flowing down the deeper hole is heated by the hot rock and brought to the surface through the second hole. The hot water is circulated through a closed-loop heat exchanger. For optimum extraction of energy from this man-made geothermal reservoir, it is vital that the absolute location of the fractured system be well established. Fracture mapping techniques include an array of downhole instrumentation. ERA

**N78-31554#** National Academy of Sciences - National Research Council, Washington, D. C. Ad Hoc Panel on Low-Btu Gasification of Coal.
**ASSESSMENT OF LOW- AND INTERMEDIATE-Btu GASIFICATION OF COAL**
Dec. 1977 114 p refs
(Contract EX-76-C-01-1216)
(FE-1216-4) Avail: NTIS HC A06/MF A01

Low- and intermediate-Btu gases made from coal may be used instead of natural gas or oil in electric power generation and industrial plants. Low-Btu gas cannot be stored economically or transmitted over appreciable distances. Production of low-Btu gas from coal may increase energy costs by approximately 200 percent above the cost of the coal. The overall thermal efficiency of the process is estimated to be about 70 to 80 percent based on cold gas purification. The use of intermediate-Btu gas involves fewer problems than the use of low-Btu gas since the heating value of the gas is high enough to reduce flame temperature limitations and feed gas volumes. It is estimated that the use of intermediate-Btu gas would raise fuel costs 200 to 300 percent above the cost of the coal. The thermal efficiency of the process is 65 to 70 percent based on gas purification at temperatures below 120 C. For the equivalent amount of energy, intermediate-Btu gas is estimated to cost 65 to 75 percent of the cost of pipeline gas produced from coal. A number of other conclusions are listed. ERA

**N78-31555#** Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
**ENERGY ANALYSIS OF MODELS OF THE UNITED STATES Annual Report**
Howard T. Odum and John F. Alexander, Jr. 15 Oct. 1977 449 p refs
(Contract EY-76-S-05-4398)
Avail: NTIS HC A19/MF A01

Systems anslysis methods are used to develop bases and environment simulation models for energy concepts and trends. For individual titles, see N78-31556 through N78-31572.

**N78-31556#** Florida Univ., Gainesville.
**ENERGY ANALYSIS OF MODELS OF THE UNITED STATES, NARRATIVE**
Howard T. Odum *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 1-18 (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

Energy bases for the United States were investigated by developing models, making quantitative evaluations, and using simulations to understand trends. Concept of energy quality, energy spectra, and structure of surviving patterns were studied. Net energies and energy quality factors were calculated with several methods and compared for coal, oil shale, water advection, casatrophes, farming inputs, soils, housing, trade, and main flows of biosphere. Models were evaluated from the state of Florida showing its basis in renewable and purchased energies. G.G.

**N78-31557#** Florida Univ., Gainesville.
**ENERGY ANALYSIS OF MODELS OF THE UNITED STATES, A SUMMARY OF PROGRESS**
John F. Alexander, Jr. *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 19-41 (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

Systems analysis was used to evolve aggregated and component models of energy relationships, to make quantitative evaluations and simulations and to calculate parameters of interest in public policy. Current progress in the energy analysis of the United States is indicated and the concurrent development of theory on energy flow relationships is outlined. G.G.

**N78-31558#** Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
**ENERGY ANALYSIS, ENERGY QUALITY, AND ENVIRONMENT**
Howard T. Odum *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 44-77 refs (For primary document see N78-31555 22-44)
(Contract E(40-1)-4398)
Avail: NTIS HC A19/MF A01

A language of energy symbol diagrams was used to develop models and organize data for energy systems analysis and synthesis. Energy analyses included calculations of: (1) net energy to evaluate primary sources; (2) an energy investment ratio to evaluate secondary sources; (3) energy savings ratios to evaluate energy conservation, (4) energy effectiveness ratios to evaluate competitive consumer roles. G.G.

**N78-31559#** Florida Univ., Gainesville.
**ENERGY MODELS OF EXCHANGE WITH SIMULATION OF THE ROLE OF EXCHANGE IN SPATIAL ORGANIZATION**
Robert Costanza *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 78-94 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

An energy model of exchange is formulated that shows energy relations to economics. Computer simulations were used to study effects of external energy resources on exchange, and the effect on spatial organization of landscapes. G.G.

**N78-31560#** Florida Univ., Gainesville.
**EFFICIENCY AND INVESTMENT MATCHING OF HIGH QUALITY ENERGY**
Michael S. Burnett *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 95-114 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

Total efficiency is defined as the energy output divided by the sum of the inputs from fossil fuel and natural sources, including embodied energy, all measured in coal equivalents. For a given energy signature or natural energy input, an optimal amount of fossil fuel investment maximize/efficiency. However, maximizing power causes operation at a lower efficiency than the maximum. G.G.

**N78-31561#** Florida Univ., Gainesville.
**ENERGY DIAGRAMS OF PUBLISHED ENERGY ANALYSIS OF OTHERS**
Howard T. Odum, John F. Alexander, Jr., D. P. Swaney, A. McCallister, E. J. Regan, Jr., M. S. Burnett, E. Titron, B. Hanley, G. Noyes, and A. Hermann *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 116-166 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

Energy analyses were compared by preparing a generalized diagram representing all results in a similar way. Numbers for dollars flows, energy flows, and storages were translated into energy circuit language. The developed diagram aggregates flows into externals, feedbacks from the main economy, and output to the main economy. G.G.

**N78-31562#** Florida Univ., Gainesville.
**A MESO-MODEL OF THE ECONOMY OF THE UNITED STATES FOR COMPARISON OF ECONOMIC AND ENERGETIC ANALYSIS**
Robert Costanza, Amy McCallister, and Jesse Boyles *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 167-173 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

A preliminary aggregated 13 sector model of the U.S. economy is presented and possible methods for including renewable energies and labor feedbacks in the calculations, as well as the effects of their inclusion on the final results, are discussed. An energy circuit diagram of the economy is also presented and utilized to discuss the relationship between these two approaches. G.G.

**N78-31563#** Florida Univ., Gainesville.
**COMPARISON OF ENERGY ANALYSIS OF OIL SHALE**
George M. Gardner *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 174-212 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

Available data and projections on net energy of oil shale were studied. Included is an energy analysis of oil production at a pilot plant near Rifle, Colorado. A review of seven net energy analyses of proposed and projected oil shale operations showed yield ratios claimed from .68 to 19.8 as compared to 6 for purchase of foreign oil. G.G.

**N78-31564#** Florida Univ., Gainesville.
**ENERGY ANALYSIS AND MODELS OF SOIL FORMATION**
Edward J. Regan, Jr. *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 213-260 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

Solar energy costs of soil energy storages were evaluated based upon an energy analysis of soil forming factors, estimates of the calorie value of soil parameters, and the rate of soil formation. The rates of soil formation were derived from literature values and a simulation model of soil formation. The results of the above analyses allow the energy storages of soil to be expressed in solar and coal equivalents. G.G.

**N78-31565#** Florida Univ., Gainesville.
**ENERGY ANALYSIS OF ORDER-DISORDER PHENOMENON OF MAN AND NATURE**
John F. Alexander, Jr. *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 261-286 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

Energy circuit analysis was used to extend general systems theory to deal with order-disorder relationships and catastrophic processes in autocatalytic systems. An amplifier concept was tested on the Guatamalan earthquake energy transmitted to adobe houses. It was found to be relatively constant for all cities analyzed. G.G.

**N78-31566#** Florida Univ., Gainesville.
**ENERGY-QUALITY CALCULATIONS FOR FRESHWATER CHEMICAL POTENTIAL**
Robert Costanza *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 287-296 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

The energy quality of fresh water chemical potential is defined as the relative ability of fresh water to do work in the production processes of the earth. The first calculation was based on process analysis in which specific energy process inputs are traced back to a common source. A biosphere approach determined the cost in solar calories of producing fresh water from rain by the ratio of total input of solar calories to the biosphere to the total quantity of rain produced. A third method of calculation was based on economic input-output analysis and yielded an estimate of the total embodied fossil fuel energy in products. A marginal productivity approach evaluated a substance's ability to do work in specific interactions by production functions. G.G.

**N78-31567#** Florida Univ., Gainesville.
**ENERGY QUALITY OF HUMIDITY AND THERMAL ADVECTION OF AIR IN FLORIDA**
Dennis P. Swaney *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 297-312 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

Extended energy circuit language was used for assessing the value of water vapor transport, using the commonly occurring parameter of relative humidity, and the value of temperature variations due to heat advection. Representative values of both are calculated for several Florida cities. The energy values obtained for these cities employed annual averages of relative humidity and wind speed, and the temperature gradients were obtained from averages over a much longer period. G.G.

**N78-31568#** Florida Univ., Gainesville.
**A HISTORIC AND CURRENT ENERGY ANALYSIS OF FLORIDA**
Neil Sipe *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 313-337 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

Energy circuit models were used to analyze Florida's current energy base as well as three periods of the state's past. These three periods, primitive, colonial, and limited agriculture, were delineated based upon primary energy sources. It is shown that Florida's growth was greatly accelerated due to the effects of war, and that the state exports luxury items to the rest of the U.S. in exchange for fossil fuels. G.G.

**N78-31569#** Florida Univ., Gainesville.
**STATISTICAL TEST OF ENERGY MODELS FOR PREDICTION OF URBAN GROWTH IN FLORIDA**
Edward J. Regan, Jr. *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 338-369 refs (For primary document

see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

A model of additive energy input to a logistic balance of input and losses provided the best correlation for predicting urban growth based on energy flows. Included were vegetation and urban production processes. The natural energies were shown to enter directly into the soil and urban production processes from the outside. G.G.

**N78-31570#** Florida Univ., Gainesville.
**SOME ASPECTS OF ENERGY USE IN HOUSING**
Mark Brown and Larry Arrington *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 400-413 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

Energy calculations are reported for a house unshaded in summer and equiped with solar hot water heating. The energy flows represent the energy required to cool the structure as a result of unshaded, exposed roof, and east, south, and west walls; and the energy cost of heating hot water with a solar heater, and also for a shaded home equipped with electric hot water heating. The difference between the shaded and unshaded house is the energy cost of maintaining a solar collector on the roof. It is shown that the energy savings for a solar collector in South Florida are 24.1 x 1 million kcal for 10 years. When the difference in the cost of cooling an unshaded house is substracted from this energy savings, the savings are substantially reduced. G.G.

**N78-31571#** Florida Univ., Gainesville.
**ENERGY ANALYSIS AND MODEL OF INTERMEDIATE AGRICULTURE**
Michael S. Burnett *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 414-429 ref (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

An energy analysis of a 160 acre low-energy homestead in Arkansas was performed. Low quality solar-driven natural energies were upgraded via the farm system to high quality meat products, which were exchanged for goods and services necessary to maintain the durable technology of the system. Animals grazing on natural improved pasture were the focal point of the energy flows. Wood use for heating, a large garden providing vegetables and fruit for fresh consumption and storage, and several small grain patches were considered important energy conservative habits. Results shown that fossil fuel energy requirements of this family are 15 percent of the American average. G.G.

**N78-31572#** Florida Univ., Gainesville.
**ENERGY ANALYSIS OF BRAZIL**
Howard T. Odum *In its* Energy Analysis of Models of the US 15 Oct. 1977 p 430-440 refs (For primary document see N78-31555 22-44)
Avail: NTIS HC A19/MF A01

An energy model for the accelerated growth of the Brazilian economy is reported that utilizes statistical data to evaluate overall flows of money ,and energy in relation to coal equivalents. A summarizing diagram shows that high quality energies of the urban development are made up of hydroelectric power and a free input of renewable resources of the sun because of the large geographic area. The renewable sunlight with its auxiliary energy of the land, soil, rain, and wind contributes six times as much energy in coal equivalents as recognized in the statistical summary of other energies. G.G.

**N78-31573#** General Atomic Co., San Diego, Calif.
**QUALITY ASSURANCE PROGRAM DOCUMENT FOR 75 mW RADIOISOTOPE THERMOELECTRIC GENERATOR PROGRAM**
B. M. Gregory Sep. 1977 16 p
(Contract EY-76-C-03-0167-060; Proj. 3246)
(GA-A-14807) Avail: NTIS HC A02/MF A01

The specifications for the design, fabrication assembly, testing, and delivery of the 75-mW electrical thermoelectric generators test units in accordance with the contractural requirements are given. The operating agreements and relationships between GA and other participants on quality assurance matters on the program are described. The equipment and activities subject to the quality assurance program and GA's scope of supply and documentation requirements for retention and delivery to the customer are identified. The customer may refer to this document in signifying approval of the quality assurance program what will be implemented by GA for the items within the scope of supply. ERA

**N78-31574#** Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.
**SOLAR PILOT PLANT, PHASE 1: PRELIMINARY DESIGN REPORT. VOLUME 7: PILOT PLANT COST, COMMERCIAL PLANT COST AND PERFORMANCE, CDRL ITEM 2**
1 Jun. 1977 140 p refs
(Contract EY-76-C-03-1109)
(SAN-1109-8/9-Vol-7) Avail: NTIS HC A07/MF A01

Cost estimates are presented for the Solar Pilot Plant by cost breakdown structure element, with a commitment schedule and an expenditure schedule. Cost estimates are given for a commercial plant, including several point costs for plants with various solar multiples and storage times. Specific questions pertaining to commercial plant design and performance data are addressed. The cost estimates are supplemented by two books of vendor and subcontractor cost data. ERA

**N78-31575#** HOLT/PROCON, Pasadena, Calif.
**PRELIMINARY DESIGN MANUAL FOR A GEOTHERMAL DEMONSTRATION PLANT AT HERBER, CALIFORNIA**
B. Holt and E. L. Ghormley Feb. 1978 149 p
(EPRI Proj. 580)
(EPRI-ER-670) Avail: NTIS HC A07/MF A01

A site description, design basis, process design, trade-off studies to optimize plant operations, and an economic analysis of the plant are presented. The plant design provides flow diagrams and equipment specifications for the energy conversion system, the cooling water system, the plant and instrument air system, the flare system, the firewater system, the electrical system, the piping system, instruments and controls, and buildings and structures. ERA

**N78-31576#** Drexel Univ., Philadelphia, Pa.
**DOUBLE-EXPOSURE COLLECTOR SYSTEM Technical Progress Report, 30 Sep. - 30 Dec. 1977**
Donald C. Larson and F. William Savery 14 Feb. 1978 21 p
(Grant EG-77-G-04-4089)
(TID-28291) Avail: NTIS HC A02/MF A01

A retrofit solar water-heating system was installed in a three-story apartment building at Drexel University. The system employs two conventional collector banks (10 PPG collectors) mounted at the latitude angle for Philadelphia of 40 deg from the horizontal and two double-exposure collectors (DEC's) mounted vertically in mirrored enclosures. The performance of the DEC units relative to conventional collectors has been calculated for both a fixed-mirror and an adjustable-mirror configuration. Instrumentation for testing the DEC units performance has been developed and is presently being installed in the apartment building. Preliminary measurements have been obtained, however, of the useful heat output of the DEC units relative to the PPG collectors; these data were obtained on two clear and cold days in December 1977. On these days the DEC units delivered 5.6 to 9.1 times more heat per panel area than the PPG collectors as the PPG collector efficiency varied from 30.2% to 11.9%. ERA

**N78-31577#** Texas Univ. at Dallas, Richardson. Center for Energy Studies.
**GEOTHERMAL EXPLORATION TECHNIQUES: A CASE STUDY Final Report**
Jim Combs Feb. 1978 71 p refs
(EPRI-ER-680) Avail: NTIS HC A04/MF A01

A critical evaluation of geothermal exploration methods and techniques are reviewed and performed. The original intent was to publish the work as a handbook; however, the information is not specific enough for that purpose. A broad general survey of geothermal exploration techniques is reported in combination with one specific case study. ERA

**N78-31578#** Utah Univ., Salt Lake City.
**APPLICATION OF DIRECT CONTACT HEAT EXCHANGERS**

**TO GEOTHERMAL POWER PRODUCTION CYCLES Project Review, 1 Dec. 1974 - 31 May 1977**
H. R. Jacobs, R. F. Boehm, and A. C. Hansen 1977 181 p refs
(Contracts EY-76-S-07-1549; EY-76-S-07-1523)
(IDO-1549-8) Avail: NTIS HC A09/MF A01

The development of direct contact heat exchanger power cycles for geothermal applications is reviewed. Results from a large experimental program on heat exchanger development as well as from many analyses of components and cycle performance and economics are given. A number of working fluids and operating conditions have been considered, and no major obstacles for the implementation of the concept were discovered. ERA

**N78-31579#** McDonnell Aircraft Co., St. Louis, Mo.
**GIROMILL WIND TUNNEL TEST AND ANALYSIS. VOLUME 1: EXECUTIVE SUMMARY Final Report, Jun. 1976 - Oct. 1977**
W. A. Moran Oct. 1977 20 p refs
(Contract EY-76-C-02-2617)
(COO-2617-4/1-Vol-1) Avail: NTIS HC A02/MF A01

Data from wind tunnel tests are compared with the Larsen cyclogiro vortex theory program employed for predicting the Giromill performance. The Giromill model had a rotor diameter of 7 ft. (2.13 meters) and a solidity (total blade area divided by rotor span times diameter) of 0.3. This was achieved by a three bladed rotor having blade chords of 8.4 in. (21.3 cm) and a span of 5 ft. (1.52 meters). The blades were modulated by use of replaceable cams, that simulated the various operating conditions, and a push rod arrangement connected to a bellcrank about the blade pivot point. Rotor RPM control was achieved with an electric motor/generator that could be used to either drive the rotor or absorb the rotor power to maintain RPM. ERA

**N78-31580#** Sandia Labs., Albuquerque, N. Mex.
**PERFORMANCE EVALUATION OF WIND ENERGY CONVERSION SYSTEMS USING THE METHOD OF BINS: CURRENT STATUS**
R. E. Akins Mar. 1978 21 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1375) Avail: NTIS HC A02/MF A01

A detailed description of the method of bins, a technique of data collection and reduction for field performance evaluation of Wind Energy Conversion Systems (WECS) is provided. The method of bins is a straightforward yet useful approach to the complex problem of relating the response of a WECS to a variable wind field. Examples of typical results obtained using the method of bins are presented. Methods of determining that the measure of performance of a WECS obtained is correct are outlined. Areas in which further modifications to the technique may be appropriate are also discussed. ERA

**N78-31581#** Los Alamos Scientific Lab., N. Mex.
**USE OF SUPERCONDUCTIVE TECHNOLOGY FOR ENERGY STORAGE AND POWER TRANSMISSION FOR LARGE POWER SYSTEMS: POWER PARKS**
W. E. Keller 1977 19 p refs Presented at Intern. Scientific Forum on an Acceptable Nuclear Energy Future of the World, Coral Gables, 7 Nov. 1977
(Contract W-7405-eng-36)
(LA-UR-77-2805; Conf-771130-2) Avail: NTIS HC A02/MF A01

A general review and technology assessment of superconducting magnets for energy storage and superconducting cables for power transmission are presented. It is concluded that the technology is now available for applying superconductivity in the power industry. ERA

**N78-31582#** Monsanto Research Corp., Dayton, Ohio.
**FORM-STABLE CRYSTALLINE POLYMER PELLETS FOR THERMAL ENERGY STORAGE, PHASE 1**
R. A. Botham, G. H. Jenkins, G. L. Ball, III, and I. O. Salyer Jul. 1977 115 p refs
(Contract EY-76-C-05-5159)
(ORO-5159-10) Avail: NTIS HC A06/MF A01

TES bed material, useful in the 120 to 140 C temperature range suitable for solar absorption air conditioning applications was developed. A Si-O-Si cross-linked HDPE pellet material, demonstrated to have a high heat of fusion value was tested. On melt/freeze cycling of these TES pellets through 400 cycles in ethylene glycol, they retained nearly 100% of their initial heat of fusion value, and had excellent form-stability characteristics, with little or no inter-particle adhesion. Testing of this TES pellet material, from analytical to a one gallon lab-scale TES unit, and finally to a 60 gallon prototype TES demonstration unit, consistently verified these results. C-C crosslinked PE products, which were slightly inferior to the Si-O-Si crosslinked PE in terms of good heat of fusion and form-stability properties, were also developed and are potential alternatives to the prime PE TES product. ERA

**N78-31583#** Waterloo Univ. (Ontario).
**CONTINUATION STUDY OF THE POTENTIAL FOR SOLAR HEATING OF BUILDINGS IN CANADA**
K. G. T. Hollands and J. F. Orgill Aug. 1977 44 p refs
(NP-23162) Avail: NTIS HC A03/MF A01

WATSUN, a computer program designed to simulate the performance of a solar heating system, was modified. The printed output form was revised to provide more information to the user, and a subroutine was added to model a solar heating system with two liquid storage subsystems. WATSUN was also compared with existing simplified design methods. The program can be used to determine the performance of a specific system for a given location and building. S.B.S.

**N78-31584#** Open Univ., Milton (England). Energy Research Group.
**ENERGY ANALYSIS AND OIL SHALE RESERVES**
D. F. Hemming Feb. 1978 25 p refs
(ERG-023) Avail: NTIS HC A02/MF A01; Secr., Energy Res. Group, Walton Hall, Milton Keynes, Engl.

Resources and reserves of shale oil throughout the world are reviewed with the United States having the largest known resources. Locations in the U.S. of these reserves are noted. An assessment of the ultimate recoverable reserves of oil available from oil shales in the world and in the U.S. is made with the economically and efficiently recoverable reserves also being given. ESA

**N78-31585#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Raumsimulation.
**ADDITIONAL THERMAL CYCLING TESTS ON SOLAR CELL PANEL SAMPLES UNDER VACUUM CONDITIONS Final Report**
Wilfried Ley and Karl-Volker Rehmann Paris ESA Jan. 1978 87 p refs
(Contract ESTEC-2311/74)
(DLR-IB-353-78/1; ESA-CR(P)-1076) Avail: NTIS HC A05/MF A01

The continuation of a comparative deep thermal cycling test on eight solar cell panel samples is described. The first test included 2500 cycles under vacuum conditions. It was decided to continue the tests for another 1000 cycles on four previously tested and three new solar cell panels. For 1000 temperature cycles (hot phase - maximum temperature +70 C; cold phase - minimum temperature -180 C) three flexible and four rigid solar cell panels were tested simultaneously. At room temperature the samples were investigated at predetermined intervals for optical, electrical, and mechanical differences. A short description of the test facility (for further details, see final report DLR-IB 353-77/178N18563) and a discussion of the obtained test results is given. Author (ESA)

**N78-31586#** National Technical Information Service, Springfield, Va.
**STATE-OF-THE-ART REVIEWS AND BIBLIOGRAPHIES ON ENERGY. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - May 1978**
Audrey S. Hundemann Jun. 1978 219 p Supersedes NTIS/PS-77/0520
(NTIS/PS-78/0586/4; NTIS/PS-77/0520) Avail: NTIS HC $28.00/MF $28.00 CSCL 10A

This updated bibliography contains 214 abstracts. Citations to bibliographies, state-of-the-art reviews, and literature surveys on various aspects of fossil fuels, wind, solar energy, hydrogen,

geothermal energy, nuclear energy and batteries are presented. A few citations pertain to electric power. GRA

**N78-31587#** Charles River Associates, Inc., Cambridge, Mass.
**INTEGRATING POLICY ANALYSIS: STUDY MODULE 7. VOLUME 2: TECHNICAL APPENDIX Final Study Module**
William R. Hughes 1978 127 p Sponsored by Northwest Energy Policy Project, Portland, Oregon
(PB-280037/3; NEPP-7-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 10A

A demand model and a supply model and an equilibrating program which ties together the demand and supply models to produce internally consistent forecasts of supply, demand, and prices are described. Tables presenting the results of high, moderate, and low energy forecasts for the Pacific Northwest are included. The methodology used in computing regional benefits and costs is discussed, as is the methodology used to estimate effects of higher energy prices on regional employment income and population. GRA

**N78-31588#** Utah State Univ., Logan.
**USE AND ABUSE OF THE REGULATORY PROCESS IN A DEVELOPING SOLAR ENERGY SPACE CONDITIONING INDUSTRY**
H. Craig Petersen and Bruce M. Owen (Stanford Univ.) Dec. 1977 60 p refs
(Grant NSF APR-75-18004)
(PB-280165/2; NSF/RA-770457) Avail: NTIS HC A04/MF A01 CSCL 05C

Emerging industries providing goods and services in competition with existing regulated industries may find that the regulatory process is used as a weapon against them to prevent their successful entry into the field. Strategic use of regulatory procedures may be as important a competitive tool for regulated industries as are the traditional weapons of price, innovation, and product differentiation in unregulated markets. Eight general possibilities for existing regulated firms and potential entrants into an industry to use the regulatory process for their own advantage are suggested. Specific ways in which gas and electric utilities or solar equipment suppliers could use these strategies to alter the rate and nature of development of a solar space conditioning industry are also discussed. GRA

**N78-31589#** National Standard Reference Data System.
**PHYSICAL PROPERTIES DATA COMPILATIONS RELEVANT TO ENERGY STORAGE. 1. MOLTEN SALTS: EUTECTIC DATA**
George J. Janz, Carolyn B. Allen, Joseph R. Downey, and R. P. T. Tomkins Mar. 1978 252 p refs
(PB-280795/6; NSRDS-NBS-61-Pt-1; LC-77-10824) Copyright. Avail: NTIS HC A12/MF A01 CSCL 07D

An authoritative compendium of melting points, and compositions of molten salt eutectic mixtures is presented. Data for mixtures melting in the range - 138 C to 2800 C are reported. Titles of the articles in the literature citations and a system index are included for approximately 6000 eutectic entries. GRA

## 45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

**N78-31590** Rhode Island Univ., Kingston.
**ATMOSPHERIC PATHWAYS OF THE PHOSPHORUS CYCLE Ph.D. Thesis**
William Frank Graham 1977 283 p
Avail: Univ. Microfilms Order No. 7813262

The flow of particulate phosphorus through the atmosphere was studied. Samples of atmospheric particulate matter were collected at urban, rural, and remote continental sites, at remote island sites, and on ship-board cover the Atlantic and Pacific Oceans. Samples of precipitation and dry fallout were collected at sampling sites at Narragansett, R.I. and Bermuda. Total phosphorus was determined on both the samples of atmospheric particulate matter and the deposition samples. In addition, the amounts of phosphorus considered to be organic and reactive were determined on the aerosol samples. Sodium, aluminum, and vanadium were also determined on the aerosol samples. These elements were used as tracers for the sea salt, crustal, and anthropogenic fossil fuel combustion portions of the aerosol. The estimated global burden of particulate phosphorus in the atmosphere is 2.8 x 10 to the 9th power g. Dissert. Abstr.

**N78-31591#** Toronto Univ. (Ontario). Inst. for Aerospace Studies.
**THE ANALYSIS OF AMBIENT AIR USING ATMOSPHERIC PRESSURE CHEMICAL IONIZATION MASS SPECTROMETRY**
N. M. Reid, J. B. French, and J. A. Buckley Jul. 1978 35 p refs
(UTIAS-219; CN-ISSN-0082-5255) Avail: NTIS HC A03/MF A01

The Trace Atmospheric Gas Analyzer technique, which is based on the use of mass spectrometry to identify and qualify ultra trace species in gases at atmospheric or near atmospheric pressure, is described. Chemical ionization, using reactant ions from a carrier to ionize traces of interest in the carrier, is used for selection of the trace gas molecules before introduction into the mass spectrometer. Specific results of the analysis of ambient air using this technique are given. S.B.S.

**N78-31592#** Naval Postgraduate School, Monterey, Calif.
**EXPERIMENTAL INVESTIGATION OF THE MARINE BOUNDARY LAYER IN SUPPORT OF AIR POLLUTION STUDIES IN THE LOS ANGELES AIR BASIN**
G. E. Schacher, C. F. Fairall, K. L. Davidson, and T. M. Houlihan Feb. 1978 251 p refs
(AD-A054239; NPS-61-78-002) Avail: NTIS HC A12/MF A01 CSCL 13/2

A four level shipboard system has been used to obtain profiles of mean wind, temperature, and humidity and to obtain distributions of temperature and wind speed fluctuations. These data have been used to characterize the marine boundary layer in the Los Angeles air basin and to obtain turbulence fluxes of momentum and sensible heat. The data show that the overwater mixing rates are much smaller than those observed on land, even though land influence can be seen as far as 30 miles from shore. Parameters have been obtained which can be used as inputs for the land-sea boundary descriptions involved in current air pollution analyses. Author (GRA)

**N78-31593#** Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**COMMUNITY NOISE EXPOSURE RESULTING FROM AIRCRAFT OPERATIONS. VOLUME 5: ACOUSTIC DATA ON AIR FORCE PROPELLER AIRCRAFT**
Jerry D. Speakman, Robert G. Powell, and Robert A. Lee Feb. 1978 703 p
(AF Proj. 723)
(AD-A055079; AMRL-TR-73-110-Vol-5) Avail: NTIS HC A99/MF A01 CSCL 01/2

This series of reports present the results of field test measurements to define the noise produced on the ground by military, fixed wing aircraft during controlled level flyovers and ground runups. For flight conditions, data are presented as a function of angle and distance to the aircraft. All of the data are normalized to standard acoustic reference conditions of 59 F temperature and 70% relative humidity. Volume 1 discusses the scope, limitations, and definitions needed to understand and use the volumes containing the noise data. It provides guidance for making airspeed and engine power setting adjustments to the flight noise data for other than reference conditions as well as work sheets and several examples for computing cumulative noise exposure resulting from multiple flight or ground runup operations. Noise data are presented in this Volume 5 for the following Air Force propeller type aircraft: C-7A; C-97L; C-118A; C-119L, C-121C, G, S, T; C-123K; C-130A, D; C-130B, E; C-130H, N, P; C-131A, B, D, E; OV-10, T-29; and U-4B. Author (GRA)

**N78-31594#** California Univ., Irvine. UCI Combustion Lab.
**MECHANISMS OF EXHAUST POLLUTANTS AND PLUME FORMATION IN CONTINUOUS COMBUSTION Final Report, 1 May 1974 - 28 Feb. 1978**
G. S. Samuelsen and R. M. Hamberg Apr. 1978 21 p refs

(Grant AF-AFOSR-2710-74; AF Proj. 2308)
(AD-A054844; UCI-ARTR-78-2; AFOSR-78-0961TR) Avail: NTIS HC A02/MF A01 CSCL 21/2

An analytical and experimental study has been conducted to promote an understanding of the processes governing the emission characteristics of continuous combustion power sources and thus provide a basis for reducing adverse environmental effects and for controlling plume signatures resulting from aircraft operation. The study addressed the development and assessment of numerical codes for backmixed flows, the formation of pollutants in backmixed flows, and questions associated with sampling oxides of nitrogen. The backmixed flow selected for study was the opposed jet laboratory combustor (OJC). GRA

**N78-31595#** Brookhaven National Lab., Upton, N. Y. Biomedical and Environmental Assessment Div.
**OUTDOOR SOURCES OF INDOOR AIR POLLUTION**
Samuel Silberstein Nov. 1977 21 p refs
(Contract EY-76-C-02-0016)
(BNL-50762) Avail: NTIS HC A02/MF A01

Conservation measures that seal a building, like storm window installation, can significantly reduce its energy requirements. These measures also protect its occupants from air pollutants having outdoor sources but amplify any harmful effects of those generated indoors. These fourier series techniques are used and an approximation of outdoor pollution peaks by step functions, the following results were obtained: the average daily concentration indoors is the same as outdoors for any pollutant with no indoor sinks if inside and outside air are assumed uniform (that is, well mixed). However, lowering a building's air exchange rate 4-fold will still protect its occupants from outdoor pollution sources, but only if the outdoor peak or variation above its average is much greater than its average, and the peak is short-lived. ERA

**N78-31596#** Research Corp. of New England, Wethersfield, Conn.
**DEVELOPMENT OF VERTICAL DISPERSION COEFFICIENTS FOR DEEP-VALLEY TERRAIN**
David H. Minott, Donald L. Shearer, and Richard S. Marker Sep. 1977 41 p refs
(Contract EY-76-C-02-4026)
(COO-4026-3) Avail: NTIS HC A03/MF A01

Results are reported from studies conducted to determine reliable dispersion coefficients for use with the Gaussian plume model, that will represent a broader range of topographic conditions than was intended for the standard Pasquill-Gifford values. Total-vertical dispersion coefficients for deep-valley terrain were developed from direct measurements of vertical dispersion made by the Norwegian Defense Research Establishment in three deep valleys, and one fjord located in northern Norway. The values developed represent mean values within stability classes and apply to continuously-emitting sources located at ground level. The implication is that the vertical dispersion rate in a deep valley is similar to the vertical dispersion rate found at non-valley locations having similar surface topography. ERA

**N78-31597#** Atomics International Div., Richland, Wash. Research Dept.
**RISK ANALYSIS IN ENVIRONMENTAL STUDIES. 1: RISK ANALYSIS METHODOLOGY, A STATISTICAL APPROACH. 2: DATA MANAGEMENT FOR ENVIRONMENTAL STUDIES**
S. Rubinstein Mar. 1978 26 p refs Presented at Waste Management 1978, Tucson, Ariz., 5-8 Mar. 1978
(Contract EY-77-C-06-1030)
(RHO-SA-33; Conf-780316-8) Avail: NTIS HC A03/MF A01

An approach to risk analysis as applied to environmental studies is proposed. Advantages of this methodology are pointed out. It utilizes modern statistical methods in order to treat risk analysis as an integral part of the study design. ERA

**N78-31598#** Bechtel Corp., San Francisco, Calif.
**FLUE GAS DESULFURIZATION SYSTEMS: DESIGN AND OPERATING CONSIDERATIONS. VOLUME 1: EXECUTIVE SUMMARY Final Report, Apr. - Dec. 1977**
C. C. Leivo Mar. 1978 29 p 2 Vol.
(Contract EPA-68-02-2616)
(PB-280253/6; EPA-600/7-78-030a) Avail: NTIS HC A03/MF A01 CSCL 13B

Flue gas desulfurization (FGD) systems and the design and operating parameters that are monitored to ensure proper operation are described. The control of parameters to prevent such problems as scale buildup is included. Effects of designing and operating FGD systems for 90% or greater SO2 removal efficiences, based on current testing program data, are considered along with effects of coal characteristics on FGD performance. Operating and design techniques used to compensate for coal property variations are discussed. Methods for exhaust gas reheat downstream of FGD systems and alternatives to exhaust gas reheat are discussed. GRA

**N78-31599#** Bechtel Corp., San Francisco, Calif.
**FLUE GAS DESULFURIZATION SYSTEMS: DESIGN AND OPERATING CONSIDERATIONS. VOLUME 2: TECHNICAL REPORT Final Report, Apr. - Dec. 1977**
C. C. Leivo Mar. 1978 221 p refs 2 Vol.
(Contract EPA-68-02-2616)
(PB-280254/4; EPA-600/7-78-030b) Avail: NTIS HC A10/MF A01 CSCL 13B
For abstract, see N78-31598.

**N78-31600#** Environmental Protection Agency, Research Triangle Park, N.C. Monitoring and Data Analysis Div.
**AIR QUALITY DATA: 1977 FIRST QUARTER STATISTICS Quarterly Report, Jan. - Mar. 1977**
Feb. 1978 149 p
(PB-280184/3; EPA-450/2-78-010) Avail: NTIS HC A07/MF A01 CSCL 13B

A statistical summary report on ambient air quality submitted to EPA from air monitoring operations of state, local, and Federal networks in accordance with requirements of the Clean Air Act and EPA Regulations for State Implementation Plans (SIPs) is presented. These data represent all ambient air quality data sampled for pollutants that currently have National Ambient Air Quality Standards. GRA

**N78-31601#** Environmental Protection Agency, Research Triangle Park, N.C. Monitoring and Data Analysis Div.
**AIR QUALITY DATA: 1977 SECOND QUARTER STATISTICS Quarterly Report, Apr. 1977 - Jun. 1977**
Feb. 1978 116 p
(PB-280185/0; EPA-450/2-78-011) Avail: NTIS HC A06/MF A01 CSCL 13B
For abstract, see N78-31600.

**N78-31602#** Environmental Protection Agency, Research Triangle Park, N.C. Monitoring and Data Analysis Div.
**AIR QUALITY DATA: 1976 FOURTH QUARTER STATISTICS Quarterly Report, Oct. 1976 - Dec. 1976**
Feb. 1978 167 p
(PB-280186/8; EPA-450/2-78-008) Avail: NTIS HC A08/MF A01 CSCL 13B
For abstract, see N78-31600.

**N78-31603#** Southern Research Inst., Birmingham, Ala.
**DEVELOPMENT OF A PORTABLE DEVICE TO COLLECT SULFURIC ACID AEROSOL**
Herbert C. Miller, David N. Mason, and William J. Barrett Mar. 1978 63 p
(Contract EPA-68-02-2468)
(PB-280048/0; SORI-EAS-77-731; EPA-600/2-78-060; Rept-3778-12) Avail: NTIS HC A04/MF A01 CSCL 07D

A quantitative, interference-free method for collecting airborne sulfuric acid aerosol on a filter was studied. Methods evaluated for direct fixation of sulfuric acid aerosol were not found to be selective. Therefore, a sampling method was investigated that used a combination of selective volatilization of the sulfuric acid, prefiltration of particulate interferents, and derivation of the vaporized acid on an alkali-impregnated filter. The initial stages of this current research on the volatilization-derivatization technique are described. GRA

**N78-31604#** Research Triangle Inst., Durham, N. C.
**NITROGEN DIOXIDE PHOTOLYTIC, RADIOMETRIC, AND METEOROLOGICAL FIELD DATA Final Report, 30 Jun. 1975 - 30 Jun. 1977**

J. E. Sickles Mar. 1978 187 p
(Contract EPA-68-02-2258)
(PB-279999/7; EPA-600/7-78-053) Avail: NTIS
HC A09/MF A01 CSCL 07D

Photolysis of nitrogen dioxide is a major reaction resulting in the formation of ozone in the troposphere. The rate constant, k1, for the photodissociation of NO2 is, under ambient conditions, a function of latitude, solar zenith angle, and cloud cover; therefore, k1 is highly variable. Nitrogen dioxide photolysis data for calculating k1, and radiometric and selected meteorological data, all under a variety of meteorological conditions, were collected during the spring and fall, 1975. GRA

**N78-31605#** Research Triangle Inst., Durham, N. C.
**ORGANIC EMISSIONS FROM AUTOMOBILE INTERIORS Final Report, Jul. 1975 - Jan. 1976**
Ruth A. Zweideinger Dec. 1977 90 p refs
(Contract EPA-68-02-1325)
(PB-280374/0; EPA-600/7-77-149) Avail: NTIS
HC A05/MF A01 CSCL 07D

Subcompact automobiles were evaluated for the emission of vinyl chloride monomer (VCM)and other organics into the passenger compartment. VCM was quantified using charcoal cartridges interfaced with gas/liquid chromatography-mass spectrometry in the single-ion detection mode. VCM levels in the Pinto, Gremlin, Vega, and Chevette were less than the 50 ppb detection limit. With improved instrumental parameters, a 2 ppb detection limit was obtained. Under these conditions, VCM was not detected in the Chevette, but was detected in the Rabbit and the Datsun 710. This analysis produced a composite list of 147 organic compounds which were identified in the automobiles. GRA

**N78-31606#** Research Triangle Inst., Durham, N. C.
**IDENTIFICATION OF COMPONENTS OF ENERGY-RELATED WASTES AND EFFLUENTS**
Edo D. Pellizari Jan. 1978 525 p refs
(Contract EPA-68-03-2368)
(PB-280203/1; EPA-600/7-78-004) Avail: NTIS
HC A22/MF A01 CSCL 07A

A state-of-the-art review on the characterization of organic and elemental substances in energy-related liquid and solid effluents was conducted. Reviewed were data on chemical elements and organic compounds in solid waste and aqueous effluents from: (1) coal liquefaction and gasification plants; (2) coal fired power plants; (3) oil shale precessors; (4) oil refineries; (5) coal mines; and (6) geothermal energy. Samples for organic and mercury analysis were subjected to a single analytical protocol in each case to permit comparison among samples. Organic constituents were analyzed by gas chromatography/mass spectrometry/computer and elemental components were determined and measured by spark-source mass spectrometry. GRA

**N78-31607*#** National Bureau of Standards, Washington, D. C.
**REACTION RATE AND PHOTOCHEMICAL DATA FOR ATMOSPHERIC CHEMISTRY, 1977**
Robert F. Hampson, Jr., ed. and David Garvin, ed. May 1978 111 p refs Sponsored in part by NASA and FAA
(NASA-CR-157610; LC-78-606033; PB-280549/7; NBS-SP-513) Avail: NTIS HC A06/MF A01 CSCL 07D

A table of data for gas phase chemical reactions and photochemistry of neutral species is presented. It gives preferred values for reaction rate constants, photoabsorption cross sections, and quantum yields of primary photochemical processes and also cites recent experimental work. It provides the basic physical chemical data needed as input data for calculations modelling atmospheric chemistry. An auxiliary table of thermochemical data for the pertinent chemical species is included in the appendix. GRA

**N78-31608#** Missouri Water Resources Center, Rolla.
**CLEANING COAL WITH COAL: COAL HUMIC ACIDS FOR REMOVAL OF ACIDS, ALKALI, SALINITY, AND HEAVY METAL POLLUTANTS ASSOCIATED WITH THE USE OF COAL AS A FUEL Final Report**
Stanley E. Manahan, John B. Green, Judith Godwin, and Bill Ting 15 Feb. 1978 184 p refs
(Contract DI-14-31-0001-4170)
(PB-280580/2; W78-06347; OWRT-B-115-MO(2)) Avail: NTIS HC A09/MF A01 CSCL 07A

The use of humic acid (HA) (a constituent of low rank coal) and fly ash (FA) as potential scrubber chemicals for the treatment of water pollution arising from coal combustion effluents is investigated. HA is characterized and purification processes are described. Cation binding by HA is believed to occur via 3 main mechanisms: (1) ortho-phenolic-carboxylic chelation, (2) intra- and intermolecular exchange of acidic groups having appreciable acidity, and (3) exchange following hydrolysis of groups on HA. The mechanism of absorption of SO2 (a primary constituent of coal combustion effluents) by sodium humates is detailed. Conclusions are: an HA-FA system is feasible; HA is effective in dissolving FA; and HA-FA solutions absorb SO2 well. GRA

**N78-31609#** Meteorology Research, Inc., Altadena, Calif.
**POLLUTANT MEASUREMENTS IN PLUMES FROM POWER PLANTS AND CITIES: A PROJECT MISTT REPORT, SUMMER 1975, FEBRUARY 1976, AND FEBRUARY 1977 Final Report, 18 Jun. 1975 - 18 Oct. 1977**
J. A. Ogren, D. L. Blumenthal, J. A. Anderson, and W. H. White Mar. 1978 63 p refs
(Contract EPA-68-01-0788)
(PB-280198/3; MR177-FR-1511; EPA-600/7-78-041) Avail: NTIS HC A04/MF A01 CSCL 07D

Airborne measurements of aerosols and poluted gases in urban and power plant plumes were conducted. Results illustrate the regional nature of air pollution. The transport of well-defined urban plumes over 150 km downwind of a city was documented during day and night conditions. Power plant plumes were sampled over 100 km downwind of the source at night and during the day over the ocean. Measurements indicated that, when the plume was not well mixed to the ground, the mass flux of sulfur in the plume did not change with distance. In urban plumes, a significant reduction in sulfur was found; only about one-third of the emissions were transported beyond 100 km downwind of the city. GRA

**N78-31610#** Environmental Monitoring and Support Lab., Research Triangle Park, N. C. Quality Assurance Branch.
**IMPROVED TEMPERATURE STABILITY OF SULFUR DIOXIDE SAMPLES COLLECTED BY THE FEDERAL REFERENCE METHOD**
Robert G. Fuerst Apr. 1978 42 p refs
(PB-279873/4; EPA-600/4-78-018) Avail: NTIS
HC A03/MF A01 CSCL 07D

The SO2 Federal Reference Method (FRM) is studied to determine if any change in reagent concentration or condition could bring about substantial retardation of the effect of temperature on the stability of collected SO2 samples. The parameters initially evaluated were pH, tetrachloromercurate (TCM), and chloroide ion concentration. With the development of a modified collecting solution based on these studies (0.04M TCM with a Hg(+2) to Cl(-) of 1/16), collection efficiency and order to reaction of the modified collecting reagent were determined. Using an Arrhenius plot of the experimental data, an equation was derived which describes the relationship between rate of decay of collected SO2 samples and temperature. The modified collecting reagent was found to increase the stability of the collected SO2 samples over a wider temperature range. GRA

**N78-31611#** Battelle Columbus Labs., Ohio.
**ORGANIC CHARACTERIZATION OF AEROSOLS AND VAPOR PHASE COMPOUNDS IN URBAN ATMOSPHERES Final Report**
G. David Mendenhall, Peter W. Jones, Paul E. Strup, and Warner L. Margard Mar. 1978 81 p refs
(Contract EPA-68-02-1409)
(PB-280050/6; EPA-600/3-78-031) Avail: NTIS
HC A05/MF A01 CSCL 07D

Organic pollutants in urban atmospheres were characterized by analyzing particulate and/or vapor-phase samples collected by EPA in St. Louis, Missouri; Miami, Florida; Denver, Colorado; Houston, Texas; and at the General Motors Test Track in Milford,

Michigan. The particulate samples were extracted with solvents and the extractable materials analyzed by elemental combustion analysis and infrared spectroscopic analysis. Ames Tests for mutagenicity on model aerosol products were also conducted. Products tested were from Toluene/NOx, 1-heptene/NOx, and alphapinene/NOx systems. None of the aerosol products from these systems showed mutagenic properties. GRA

**N78-31612#** Acurex Corp., Mountain View, Calif. Energy and Environmental Div.

**CONTROL TECHNIQUES FOR NITROGEN OXIDES EMISSIONS FROM STATIONARY SOURCES - SECOND EDITION Final Report**

R. M. Evans, R. J. Schreiber, H. B. Mason, W. M. Toy, and L. R. Waterland Jan. 1978 387 p
(Contract EPA-68-02-2611)
(PB-280034/0; ACUREX/TR-77/87) Avail: NTIS HC A17/MF A01 CSCL 07A

Information on NOx emissions covers achievable control levels and alternative methods of prevention and control of NOx emissions; alternative fuels, processes, and operating methods which reduce NOx emissions; cost of NOx control methods, installation, and operation; and the energy requirements and environmental impacts of the NOx emission control technology. Each stationary source of NOx emissions was discussed along with the various control techniques and process modifications available to reduce NOx emissions. Various combinations of equipment process conditions and fuel types are identified and evaluated for NOx emission control. GRA

**N78-31613#** GCA Corp., Bedford, Mass. GCA Technology Div.

**DEVELOPMENT AND FABRICATION OF A PROTOTYPE FIBROUS AEROSOL MONITOR (FAM)**

Pedro Lilienfeld Dec. 1977 86 p refs
(Contract PHS-NIOSH-210-76-0110)
(PB-280126/4; EPA-600/7-77-147) Avail: NTIS HC A05/MF A01 CSCL 14B

Prototype instruments capable of ream-time selective detection and measurement of airborne fibrous-shaped particles were developed. The selective detection of the fibers is effected by synchronous detection of the resulting modulation of the light scattered from a continuous-wave helium-neon laser beam by the rotating particles. The theory of operation, design of the electric-optical detection configuration and the electronic signal processing method are discussed. By means of a scattering pulse sharpness discrimination technique, fibers whose length exceed a selectable value are detected and their number concentration digitally displayed. A concentration of the order of one fiber per cubic centimeter can be assessed within a relative standard deviation of 10 percent with a counting period of 10 minutes. Tests with crocidolite and crysotile asbestos as well as with glass fibers were performed in the laboratory and the results indicate good correlation with the standard NIOSH phase contrast microscopy filter counting method. GRA

**N78-31614#** Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.

**PROCEDURES FOR QUANTIFYING RELATIONSHIPS BETWEEN PHOTOCHEMICAL OXIDANTS AND PRECURSORS: SUPPORTING DOCUMENTATION**

W. P. Freas, E. L. Martinez, E. L. Meyer, N. C. Possiel, and D. H. Sennett Feb. 1978 109 p refs
(PB-280058/9; EPA-450/2-77-021b) Avail: NTIS HC A06/MF A01 CSCL 04A

An empirical kinetic modeling approach was used to describe: (1) procedures for estimating the prevailing 6-9 a.m. NMHC/NOx ratio for a city; (2) the use of default NMHC/NOx ratios; (3) procedures for estimating transported ozone concentrations; and (4) the results of kinetic model simulations for a range of meteorological conditions and precursor levels. Topics which have general significance in a number of different procedures for quantifying ozone-precursor relationships included the prevailing background concentration of ozone and the greater importance of transported ozone as opposed to transported precursors. GRA

**N78-31615#** Institute of Gas Technology, Chicago, Ill. Applied Combustion Research.

**BURNER DESIGN CRITERIA FOR NOx CONTROL FROM LOW-BTU GAS COMBUSTION: VOLUME 2. ELEVATED FUEL TEMPERATURE Final Report, Oct. 1976 - Oct. 1977**

Donald R. Shoffstall and Ricchard T. Waibel Dec. 1977 87 p
(Contract EPA-68-02-1360)
(PB-280199/1; EPA-600/7-77-094b) Avail: NTIS HC A05/MF A01 CSCL 21D

The results of a program to provide quantitative data on combustion emissions from high-temperature low-Btu gas are given. The experimental results were gathered from a pilot-scale furnace fired with a movable-vane boiler burner at a heat input of 0.66 MW (2.25 million Btu/hr). The gases tested in this program--Winkler oxygen, Koppers-Totzek oxygen, and Wellman-Galusha air--ranged from 5.8 MJ/cu m (156 Btu/cu ft) to 9.9 MJ/cu m (266 Btu/cu ft). Measurements were made of NO emissions, temperatures within the flame, and flame emissivity. A mathematical model was used to predict the efficiencies of the furnace with the various fuels; the model agreed well with the experimental measurements. The NO emissions of the gases tested were ordered by the adiabatic flame temperature. GRA

**N78-31616#** Environmental Protection Agency, Washington, D. C. Water Planning Div.

**WATER QUALITY MANAGEMENT GUIDANCE FOR MINE-RELATED POLLUTION SOURCES (NEW, CURRENT AND ABANDONED) Final Report**

Dan Deely Dec. 1977 212 p refs
(PB-280625/5; EPA-440/3-77-027) Avail: NTIS HC A10/MF A01 CSCL 13B

Prevention and control of water pollution from new, current and/or abandoned mine-related pollution sources was considered. Aspects of mine-related water quality management plant development, which are separately explained and discussed, include water pollution source identification and assessment, current source control, identification and use of best management practices, abandoned source abatement, new source planning, and continuing water quality planning and management. Information presented includes mining regulatory control system features needed for effective water pollution prevention and control, basic mining water pollution control principles, and distinctions between point sources and nonpoint sources. GRA

**N78-31617#** Environmental Protection Agency, Kansas City, Mo.

**PROPOSED ISSUANCE OF A NEW SOURCE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT NO. IA-0060909 TO IOWA SOUTHERN UTILITIES COMPANY, OTTUMWA GENERATING STATION FOR DISCHARGE OF WASTEWATERS TO THE DES MOINES RIVER NEAR OTTUMWA, IOWA**

Jul. 1977 507 p Prepared in cooperation with Army Engineer District, Rock Island, Ill., and Black and Veatch, Kansas City, Mo.
(PB-280369/0; EPA-7-IA-OTTUMWA-W-NSDP-77) Avail: NTIS HC A22/MF A01 CSCL 13B

The proposed site for the 727 megawatt coal-fired steam-electric generating station is located adjacent to the Des Moines River approximately 8 miles northwest of Ottumwa, Iowa. A closed-cycle cooling system requires make-up water at a rate of 17 cfs at maximum load conditions. Total discharge to the Des Moines River is estimated to be 1.4 cfs at maximum load conditions. Principal constituents of plant stack emissions are particulate matter, sulfur oxides, nitrogen oxides and various trace elements. An electrostatic precipator controls particulate matter. Selection of low sulfur coal minimizes SO2 emissions, and furnace design controls NO2. GRA

**N78-31618#** National Technical Information Service, Springfield, Va.

**AIRCRAFT AIR POLLUTION, VOLUME 3. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1977 - Jun. 1978**

Diane M. Cavagnaro Jun. 1978 95 p Supersedes NTIS/PS-77/0570; NTIS/PS-76/0529
(NTIS/PS-78/0623/5) Avail: NTIS HC $28.00/MF $28.00 CSCL 04A

Citations include: (1) pollution control and abatement, (2)

emissions data and emission factors, stratospheric pollution, (4) effects the supersonic transport traffic have on the environment, and (5) pollutant concentrations and movement around airports and flight corridors. GRA

**N78-31619#** National Technical Information Service, Springfield, Va.
**LINEAR PROGRAMMING IN MANAGEMENT. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - May 1978**
George W. Reimherr Jun. 1978 86 p Supersedes NTIS/PS-77/0541, NTIS/PS-76/0488, NTIS/PS-75/406
(NTIS/PS-78/0604/5; NTIS/PS-77/0541) Avail: NTIS HC $28.00/MF $28.00 CSCL 04A

Government-sponsored research reports concerning linear programming as an aid to the management decision making process are cited. Models are included in the bibliography for various management situations in different industries. GRA

**N78-31620#** National Technical Information Service, Springfield, Va.
**HIGHWAY TRAFFIC NOISE. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Jun. 1978**
Edith Kenton Jun. 1978 190 p Supersedes NTIS/PS-77/0518; NTIS/PS-76/0470; NTIS/PS-75/444; COM-74-10971
(NTIS/PS-78/0634/2; NTIS/PS-77/0518; NTIS/PS-76/0470; NTIS/PS-75/444; COM-74-10971) Avail: NTIS HC $28.00/MF $28.00 CSCL 13B

The citations relate to many aspects of highway noise and its reduction. Studies include transportation noise models, environmental aspects, noise sources, tire-pavement studies, noise barrier design, noise levels, and research in the field. The bibliography also covers highway planning and Government policies in connection with noise pollution abatement and control strategies. Central city investigations are in general excluded. GRA

**N78-31621#** Drexel Univ., Philadelphia, Pa.
**PHYSICAL AND CHEMICAL PHENOMENA RESPONSIBLE FOR ODOR FORMATION IN DIESEL ENGINES Interim Progress Report, Jun. - Dec. 1977**
N. P. Cernansky, C. W. Savery, I. H. Suffet, and R. S. Cohen Jan. 1978 77 p refs
(Grant NSF AER-76-19752)
(PB-280544/8; NSF/RA-780046) Avail: NTIS HC A05/MF A01 CSCL 07D

A single cylinder CFR diesel engine test facility was modified and instrumented for studying the formation and control of odors in light duty diesel engines. Exploratory odor samples (about 400) from both the engine and burner were collected and analyzed. It is indicated that sample volume and sampling rate have a significant effect on measured odor and that significant odor breakthrough can and does occur in the odor sampling traps. Steady-state odor mapping of the engine system indicates that odor emissions are relatively insensitive to speed and injection angle but that load, compression ratio, ignition delay, and fuel factors can have a significant effect on odor production. GRA

**N78-31622#** Kansas Water Resources Research Inst., Manhattan.
**DIVERSITY OF STREAM COMMUNITIES UNDER CONDITIONS OF POLLUTION STRESS**
Roger L. Kaesler Feb. 1978 40 p refs
(Contract DI-14-31-0001-5200)
(PB-280500/0; Contrib-193; W78-06409; OWRT-C-6-007(5200)(5)) Avail: NTIS HC A03/MF A01 CSCL 13B

The index of diversity most appropriate for stream surveys was studied to find, if possible, ranges of diversity indicative of healthy streams, moderate pollution, and heavy pollution, and to develop and test means of reducing the cost of stream surveys by considering taxonomic categories above the species level, such as families and genera, the value of small samples, and nontaxonomic hierarchies. By using Brillouins index, the size of samples collected is reduced and, hence, the cost of the field survey and the time needed to collect data in the laboratory. Moreover, some purposes of applied aquatic ecology are served by working with families or genera rather than species, again with appreciable savings of time and money. GRA

**N78-31623#** Illinois Univ. at Urbana-Champaign, Urbana.
**ALTERNATIVE POLICIES FOR CONTROLLING NONPOINT AGRICULTURAL SOURCES OF WATER POLLUTION Final Report, 26 Jan. 1976 - 25 Apr. 1977**
W. D. Seitz, D. M. Gardner, S. K. Gove, K. L. Guntermann, and J. R. Karr Apr. 1978 331 p refs
(Contract EPA-68-01-3584)
(PB-280757/6; EPA-600/5-78-005) Avail: NTIS HC A15/MF A01 CSCL 13B

Policies representing a variety of approaches to the control of water pollution from nonpoint agricultural sources are analyzed. The aggregate economic impact of such policies is investigated using a state-of-the-art, market-equilibrium linear programming model of crop production in the corn belt. The economic effects of the policies at the level of individual farms and their impacts on long-term soil productivity are analyzed through the use of a watershed model. The institutional arrangements needed to implement the policies are examined, as are the associated costs for a typical county. GRA

**N78-31624#** Kent State Univ., Ohio.
**EFFECTS OF DIVERSION AND ALUM APPLICATION ON TWO EUTROPHIC LAKES Final Report, Nov. 1971 - Jun. 1977**
G. Dennis Cooke, Robert T. Heath, Robert H. Kennedy, and Murray R. McComas Mar. 1978 117 p refs
(Contract EPA-R-801936)
(PB-280983/8; EPA-600/3-78-033) Avail: NTIS HC A06/MF A01 CSCL 13B

The reduction of eutrophication by reducing sediment P release was studied. The two methods used were septic tank diversion and hypolimnetic doses of alum. After diversion, P in lakes and streams declined and plankton biomass remained those of moderately eutrophic lakes, and P income remained above permissible. Nonpoint sources were important. In laboratory and field tests, maximum dose, which is related to alkalinity and determined by 'jar tests', was effective in retarding P release from sediments. GRA

**N78-31625#** Entropy Environmentalists, Inc., Research Triangle Park, N.C.
**REGULATIONS AND RESOURCE FILE OF CONTINUOUS MONITORING INFORMATION Interim Report**
William J. Pate Feb. 1978 193 p refs
(Contract EPA-68-01-4148)
(PB-280975/4; EPA-340/1-78-002) Avail: NTIS HC A09/MF A01 CSCL 13B

EPA organizations and personnel involved with continuous emission monitoring, continuous emission monitoring regulations, vendors of continuous monitoring equipmemt, and a bibliography of continuous monitoring literature are given. GRA

**N78-31626#** Chesapeake Research Consortium, Inc., Baltimore, Md.
**PROCEEDINGS OF THE BI-STATE CONFERENCE ON THE CHESAPEAKE BAY**
Oct. 1977 303 p Conf. held at Baltimore, 27-29 Apr. 1977 Sponsored in part by Fish and Wildlife Service, Washington, D. C.
(Grants NSF ENV-74-24271; EPA-R-003129-01)
(PB-282155/1; CRC-PUB-61; NSF/RA-770514; LC-77-20344) Avail: NTIS HC A14/MF A01 CSCL 13B

The task force reports from the workshops, the panelists' responses and other papers presented at the conference are reported. The task force reports cover the following topics: maritime development; toxic substances; prevention and control of spills; fisheries and wildlife; and non point pollution. GRA

**N78-31700#** Joint Publications Research Service, Arlington, Va.
**THE ROLE OF TECHNOLOGICAL AND LAY-OUT FACTORS, AS WELL AS CLIMATE, IN FORMATION OF THE AIR BASIN IN THE REGION OF CHEMICAL PLANTS**
A. P. Mikhayluts *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 53-59 refs Transl. into ENGLISH from Gig. Tr. (Moscow), no. 6, 1978 p 6-11 (For primary document see N78-31697

22-51)
Copyright. Avail: NTIS HC A05/MF A01

**N78-31701#** Joint Publications Research Service, Arlington, Va.
**ON THE QUESTION OF RAPIDLY SETTING HYGIENIC STANDARDS FOR INDUSTRIAL SUBSTANCES WITH IRRITANT ACTION**
N. G. Ivanov *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 60-63 refs Transl. into ENGLISH from Gig. Tr. (Moscow), no. 6, 1978 p 50-52 (For primary document see N78-31697 22-51)
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# 46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

**N78-31627** California Univ., Berkeley.
**TELLURIC AND D. C. RESISTIVITY TECHNIQUES APPLIED TO THE GEOPHYSICAL INVESTIGATION OF BASIN AND RANGE GEOTHERMAL SYSTEMS Ph.D. Thesis**
John Henry Beyer, Jr. 1977 475 p
Avail: Univ. Microfilms Order No. 7812493

In recent years considerable interest has developed in the use of geothermal energy. However, much of the exploration technology which exists to find and delineate the features of geothermal systems is in its infancy. Several electrical techniques as applied to geothermal exploration are divided into three independent parts. A natural field electrical exploration technique, the E-field ratio telluric method is described in Part 1. Two dimensional numerical model study and comparison of the polar dipole-dipole and Schlumberger resistivity arrays is described in Part 2. A detailed interpretation of E-field ratio telluric, bipole-dipole restivity mapping, and dipole-dipole resistivity data obtained in the course of geophysical exploration of the Leach Hot Springs area of Grass Valley, Nevada is discussed in Part 3.
Dissert. Abstr.

**N78-31628** California Univ., San Diego.
**ALFVEN/ION CYCLOTRON WAVES AND THE ION CYCLOTRON INSTABILITY IN THE EARTH'S MAGNETOSPHERE Ph.D.. Thesis**
Barry Hulett Mauk 1978 159 p
Avail: Univ. Microfilms Order No. 7813147

The ATS-6 geosynchronous satellite has observed in both plasma particle and magnetic field data many examples of propagating, electromagnetic Alfven/ion cyclotron waves (omega/Omega is approximately 0.05 to 0.5) predominantly near the afternoon and dust regions of the earth's magnetosphere. These wave-plasma coincidences suggest the popular yet largely untested ion cyclotron plasma instability as the wave generation mechanism. Calculations indicate that the measured frequencies for both events are in good agreement with those values which are predicted from the peak amplification profiles which are obtained by evaluating the resonant, linear, ion cyclotron growth rate integrals under the measured, anisotropic, hot ion distribution functions.
Dissert. Abstr.

**N78-31629** Arizona State Univ., Tempe.
**COBALT AS AN ANALOGUE FOR IRON IN HIGH TEMPERATURE EXPERIMENTS ON BASALTIC COMPOSITIONS Ph.D. Thesis**
William Ellsworth Coons, III 1978 181 p
Avail: Univ. Microfilms Order No. 7812016

The cobalt analogue technique is a useful method for circumventing the iron loss problem. Equimolar substitution of CoO for FeO produces an analogue composition which faithfully reproduces the topology of phase diagrams of natural compositions. In this method, Fe2O3 is retained as Fe2O3 and the experiments are run at an elevated oxygen fugacity. Under this high oxygen fugacity, metal loss to the capsule is negligible, thus a constant composition is maintained. The compositions of coexisting olivine and liquid or orthopyoxene and liquid from the cobalt bearing system are used to infer compositions in the natural, iron bearing system.
Dissert. Abstr.

**N78-31630** California Inst. of Tech., Pasadena.
**STUDY OF MAGMA SOURCES, MANTLE STRUCTURE AND THE DIFFERENTIATION OF THE EARTH FROM VARIATIONS OF Nd-143/Nd-144 IN IGNEOUS ROCKS Ph.D. Thesis**
Donald James DePaolo 1978 373 p
Avail: Univ. Microfilms Order No. 7813501

Nd-143/Nd-144 was measured in terrestrial rock samples of different ages to establish the characteristics of Nd isotopic evolution in the crust and mantle. Many continental igneous rocks are derived from a reservoir with chondritic REE pattern which may represent primary undifferentiated material remaining since the formation of the earth, while oceanic igneous rocks are derived from highly differentiated reservoirs. The mantle beneath the oceans appears to be more depleted in crustal components than is the mantle which is subjacent to the continental crust. In general, basalts are not derived from mantle reservoirs which have been light REE-enriched for long times.
Dissert. Abstr.

**N78-31631** Washington Univ., Seattle.
**A STUDY OF THE GEOCHEMISTRY OF PELAGIC SEDIMENTS: THE INTERACTION OF TRACE METALS AND MAGNETIC MINERALS WITH SEDIMENTARY ENVIRONMENTS Ph.D. Thesis**
Paul Carrington Henshaw, Jr. 1978 253 p
Avail: Univ. Microfilms Order No. 78-14440

Red clays from the central north Pacific often have a high concentration of hydrogenous, trace metal-rich phases and display magnetic properties characteristic of paleomagnetically unreliable sediments. Comparison of cores from the pelagic red clay zone with cores from other pelagic regions shows that the trace-metal-rich phases are associated with the magnetic separates of the unreliable cores, whereas these phases are associated with the non-magnetic fraction in paleomagnetically reliable cores. In areas where oxidizing conditions persist in the sediments after burial, ferromanganese phases in the form of micronodules or surface coatings, remain intact, providing a large hydrogenous component to the sediment. The major cause of paleomagnetic unreliability is the chemical remanent magnetization caused by a single domain, ferromanganese mineral, perhaps todorokite.
Dissert. Abstr.

**N78-31632*#** Science Applications, Inc., Huntsville, Ala.
**A COMPUTER VERSION OF THE US STANDARD ATMOSPHERE, 1978**
R. L. King Aug. 1978 49 p refs
(Contract NAS8-32226)
(NASA-CR-150778) Avail: NTIS HC A03/MF A01 CSCL 04A

A computer version of the U.S. Standard Atmosphere, 1976, was developed. The computer program was developed in modular form for easy incorporation into the user's program and for easy modification for specialized uses.
L.S.

**N78-31633*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE GEOID SPECTRUM FROM ALTIMETRY**
C. A. Wagner Jul. 1978 29 p refs Submitted for publication
(NASA-TM-79583) Avail: NTIS HC A03/MF A01 CSCL 08E

Satellite altimetry information from the world's major oceans was analyzed to arrive at a geoid power spectrum. Using the equivalent of about 7 revolutions of data (mostly from GEOS-3) the power spectrum of the sea surface generally follows the expected values from Kaula's rule applied to the geoid. Analysis of overlapping altimetry arcs (and oceanographic data) shows that the surface spectrum is dominated by the geoid to about 500 cycles (40 km half wavelength) but that sea state departures are significant starting at about 250 cycles (80 km). Estimates of geopotential variances from a derived (smooth) geoid spectrum show significantly less power than Kaula's rule to about 60 cycles, but somewhat more from there to about 400 cycles. At less than 40 km half wavelength, the total power in the marine geoid may be negligible.
Author

**N78-31634*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GRAVITATIONAL SPECTRA FROM DIRECT MEASUREMENTS**
C. A. Wagner and O. L. Colombo Aug. 1978 34 p refs
(NASA-TM-79603) Avail: NTIS HC A03/MF A01 CSCL 08N

A simple rapid method is described for determining the spectrum of a surface field from harmonic analysis of direct measurements along great circle arcs. The method is shown to give excellent overall trends to very high degree from even a few short arcs of satellite data. Three examples are taken with perfect measurements of satellite tracking over a planet made up of hundreds of point-masses using (1) altimetric heights from a low orbiting spacecraft, (2) velocity residuals between a low and a high satellite in circular orbits, and (3) range-rate data between a station at infinity and a satellite in highly eccentric orbit. In particular, the smoothed spectrum of the Earth's gravitational field is determined to about degree 400(50 km half wavelength) from 1 D x 1 D gravimetry and the equivalent of 11 revolutions of Geos 3 and Skylab altimetry. This measurement shows there is about 46 cm of geoid height remaining in the field beyond degree 180. L.S.

**N78-31635*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE UTILITY OF SURFACE MAGNETIC FIELD MEASUREMENTS IN THE MAGSAT PROGRAM**
Robert A. Langel, E. B. Fabiano (Geological Survey, Denver, Colo.), and G. D. Mead Aug. 1978 12 p Submitted for publication
(NASA-TM-79614) Avail: NTIS HC A02/MF A01 CSCL 08N

To take full advantage of the global, vector, survey by the Magsat satellite, and international program of augmented surface measurements was proposed. For secular variation and upper mantle conductivity the proposed measurements are global. The repeat station measurements for secular variation should be occupied at 2-3 year intervals. A special observing period in November and December of 1979 is proposed during which simultaneous, continuous, global measurements for upper mantle conductivity studies are to be gathered. Finally, it is recommended that the networks in operation during the IMS extend their operation through the Fall of 1980 to provide correlative data useful for high latitude disturbance studies and for crustal conductivity studies. Author

**N78-31636#** Geophysical Observatory, Sodankyla (Finland).
**ON THE RELATIVE LOCATION OF THE PLASMAPAUSE AND THE HF BACKSCATTER CURTAINS**
Tauno Turunen and Juhani Oksman (Max-Planck-Inst. fuer Aeronomie) Aug. 1978 16 p refs
(Rept-23) Avail: NTIS HC A02/MF A01

The location of HF backscatter curtains in the F region, measured by means of sweep frequency sounders at Nurmijarvi, Finland, and Lindau, FRG, was compared with the location of the plasmapause, determined by using whistlers recorded in Northern Finland at an L-value of about 5.6, during the night 28.02. - 01.03.1977. The backscatter curtains seem to fall into two groups. The first group appears at high L-values outside the plasmapause in the afternoon and moves to lower L-values nearer the plasmapause with increasing local time. The second group lies constantly at lower L-values than the plasmapause. Author

**N78-31637#** Army Cold Regions Research and Engineering Lab., Hanover, N. H.
**BEARING CAPACITY OF RIVER ICE FOR VEHICLES**
Donald E. Nevel Apr. 1978 26 p refs
(DA Proj. 1T0-62112-A-130)
(AD-A055244; CRREL-78-3) Avail: NTIS HC A03/MF A01 CSCL 08/12

The mathematical theory for the bearing capacity of river ice for vehicles is presented. The floating ice sheet is assumed to have simple supports at the shore line. Solutions are presented for loads uniformly distributed over circular and rectangular areas. Numerical evaluations are made for a number of vehicles and the results presented in graphical form. Author (GRA)

**N78-31638#** Army Cold Regions Research and Engineering Lab., Hanover, N. H.
**A COMPARISON BETWEEN DERIVED INTERNAL DIELECTRIC PROPERTIES AND RADIO-ECHO SOUNDING RECORDS OF THE ICE SHEET AT CAPE FOLGER, ANTARCTICA**
T. E. Keliher and S. F. Ackley Apr. 1978 21 p refs
(DA Proj. 4A1-61102-AT-24)
(AD-A055245; CRREL-78-4) Avail: NTIS HC A02/MF A01 CSCL 08/12

The use of radio-echo sounding records to indicate the presence of internal layers within large ice sheets is of interest to glaciologists because it offers a means of tracking the internal properties of the ice sheets over large distances. The interpretation of the reflections obtained in this manner is more valuable, however, if a physical property change relating to the glaciological regime can be related to the dielectric property change producing the radio-echo reflections. In this report, we use the measured physical properties of core to bedrock taken at Cape Folger, East Antarctica (66 deg 22 min s, 111 deg (E), 324-m depth), to compute a profile of dielectric properties and from this, a depth-reflection coefficient profile for comparison with observed radio-echo reflections. The measurements available on physical properties are: density variations, bubble size and shape changes, and crystal fabric variations. The depths of the strong reflections shown on the available radio-echo records are in reasonable agreement with the depths corresponding to the highest reflection coefficients computed from the combined physical property measurements. In calculations to differentiate the separate effects of different physical properties, it appears that density variations account for the primary contributions to the calculated dielectric property changes corresponding to the highest reflection coefficients. However, bubble changes alone can also account for reasonable, though lower, reflection coefficients at the appropriate depths. Crystal fabric variations correspond poorly with the reflection locations. Density variations are normally associated with depositional events in the history of the ice sheet. GRA

**N78-31639#** Army Cold Regions Research and Engineering Lab., Hanover, N. H.
**THE COMPRESSION OF WET SNOW**
S. C. Colbeck, K. A. Shaw, and G. Lemieux Apr. 1978 27 p refs
(DA Proj. 4A1-61102-AT-24)
(AD-A055246; CRREL-78-10) Avail: NTIS HC A03/MF A01 CSCL 08/12

The compressibility of wet snow is described in terms of pressure melting and nonlinear viscous deformation at grain contacts. The results of experiments with different salinities and liquid water contents are compared with computed densities. The decreasing compressibility of wet snow with increasing salinity and decreasing liquid content is quantified and explained. Simultaneous particle growth and the doubly charged layer at phase boundaries are included in the model. The results show that the density of wet snow increases approximately as a power of time but is highly dependent on the stress, initial particle size, liquid water content, and ionic impurity content of the snow. Author (GRA)

**N78-31640#** Air Force Geophysics Lab., Hanscom AFB, Mass.
**MEASUREMENTS OF ATMOSPHERIC DENSITY AT KWAJALEIN ATOLL, 18 MAY 1977 Air Force Surveys in Geophysics**
C. R. Philbrick, A. C. Faire, and D. H. Fryklund Jan. 1978 111 p refs
(AD-A054784; AFGL-TR-78-0058; AFGL-AFSG-384) Avail: NTIS HC A06/MF A01 CSCL 04/1

A triaxial piezoelectric accelerometer has been used to measure atmospheric drag acceleration on a falling sphere to determined atmospheric density. The technique allows determination of atmospheric density between 50 and 150 km, with an accuracy better than 5 percent and with an altitude resolution of about 200 m. Comparisons have been made with radar determined drag acceleration measurements, with rocketsonde measurements, and with passive Robin sphere density measurements during the same period. Author (GRA)

**N78-31641#** Stanford Research Inst., Menlo Park, Calif.
**TWO FORTRAN PROGRAMS FOR CALCULATING GLOBAL**

**IONOSPHERIC AMPLITUDE AND PHASE SCINTILLATION Final Technical Report, 15 May 1976 - 15 Jul. 1977**
Charles L. Rino, Edward J. Fremouw, Anne R. Hessing, and V. Elaine Hatfield Apr. 1978 68 p refs
(Contract F30602-75-C-0236; ARPA Order 2777)
(AD-A055273; RADC-TR-78-87) Avail: NTIS HC A04/MF A01 CSCL 04/1

This report contains detailed descriptions of the FORTRAN computer codes IONSCNT, which calculates average ionospheric amplitude and phase scintillation conditions on a global basis, and the auxiliary statistics program DIST, which uses the IONSCNT outputs to calculate fading statistics. Operating instructions for the programs together with examples and descriptions of the various outputs are included. The theoretical background and data base for the program development is contained in a separately published report. GRA

**N78-31642#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**GEODSS EXPERIMENTAL TEST SYSTEM PARTICIPATION IN PROJECT EXCEDE**
D. E. Beatty 8 Mar. 1978 19 p ref
(Contract F19628-78-C-0002; AF Proj. 2128)
(AD-A055264; ETS-33; ESD-TR-78-33) Avail: NTIS HC A02/MF A01 CSCL 17/8

The GEODSS Experimental Test System participated in Project EXCEDE. The experiment involved tracking the optical emissions induced in the atmosphere by an energetic electron source. Since the flight path of the electron aurora fell within the operational limits of the GEODSS system, the tracking mission was undertaken. Tracking was successful. Using both the 14 in. and the 31 in. telescopes, rate and position information were recorded on both digital magnetic tape and video tape. This data, along with several Polaroid photos (all of which will be used by the AFGL for data analysis) illustrate the atmospheric effects caused by the electron beam. GRA

**N78-31643#** Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
**ATMOSPHERIC CO2 INFRARED BACKGROUND INVESTIGATION. EXPERIMENTAL CONFIGURATION OF 2.7 TO 4.3 MICROMETERS FLUORESCENCE MODELING OF 4.3 MICROMETERS SPECTRAL STRUCTURE Final Report, 11 May - 31 Dec. 1977**
J. B. Kumer and T. C. James Dec. 1977 82 p refs
(Contract DNA001-77-C-0190)
(AD-A055943; AD-E300226; LMSC-D566309; DNA-HAES-70; DNA-4409F) Avail: NTIS HC A05/MF A01 CSCL 07/4

The High Altitude Effects Simulation (HAES) Program compromises several groupings of separate, but interrelated technical activities, e.g., ICECAP (Infrared Chemistry Experiments-Coordinated Auroral Program). Each of the latter have the common objectives of providing information ascertained as essential for the development and validation of predictive computer codes designed for use with high priority DoD radar, communications, and optical defensive systems. Since the inception of the HAES Program, significant achievements and results have been described in reports published by DNA, participating service laboratories, and supportive organizations. This report is the 70th report in the HAES series. GRA

**N78-31644#** General Electric Co., Santa Barbara, Calif. DASIAC
**REACTION RATE DATA, NUMBER 61**
Oct. 1977 21 p
(Contract DNA001-75-C-0023)
(AD-A055983) Avail: NTIS HC A02/MF A01 CSCL 04/1

This issue of the DASIAC Reaction Rate Data presents summaries of recent progress in investigations supported by the Defense Nuclear Agency in portions of its Reaction Rate Program, plus summaries of related work submitted by other non-DNA-funded investigators. GRA

**N78-31645#** Army Engineer Waterways Experiment Station, Vicksburg, Miss.
**STATE-OF-THE-ART FOR ASSESSING EARTHQUAKE HAZARDS IN THE UNITED STATES. REPORT 9: CATALOGUES OF STRONG MOTION EARTHQUAKE RECORDS. VOLUME 1: WESTERN UNITED STATES, 1933-1971**
Frank K. Chang Apr. 1978 57 p refs
(AD-A055971; WES-MP-S-73-1-9-Vol-121) Avail: NTIS HC A04/MF A01 CSCL 08/11

A working catalogue was prepared to facilitate the selection of strong motion earthquake records for design purposes. The records are those processed by the California Institute of Technology from western United States during the period 1933-1971. They are presented graphically in terms of magnitude, type of fault, focal depth, site classification, peak acceleration velocity, displacement, duration, and distance from epicenter. Author (GRA)

**N78-31646#** Parametrics, Inc., Waltham, Mass.
**ATMOSPHERIC DENSITY MEASUREMENT IN THE MIDDLE ATMOSPHERE Annual Report, 1 May 1976 - 30 Jun. 1977**
Bach Sellers and Jean L. Hunerwadel Aug. 1977 42 p refs
(Contract DAAG29-76-C-0041)
(AD-A055773; PANA-AIR-2) Avail: NTIS HC A03/MF A01 CSCL 04/1

A density gauge for use in the 20-90 km range of the atmosphere was developed. It is based on beta-ray forward scattering and uses a Pm-147 beta source. Estimated accuracy is - or - 6% or better for launch on an Arcas having apogee near 90 km. The flight model will be ready for integration into the Arcas by March, 1978. A flight program for the sonde is recommended, and techniques offering potential for application of the method up to 100 km are discussed. GRA

**N78-31647#** Army Cold Regions Research and Engineering Lab., Hanover, N. H.
**SEGREGATION FREEZING AS THE CAUSE OF SUCTION FORCE FOR ICE LENS FORMATION**
Shunsuke Takagi Apr. 1978 19 p refs
(DA Proj. 4A1-61102-AT-24; DA Proj. 4A1-61101-A-91D)
(AD-A055780; CRREL-78-6) Avail: NTIS HC A02/MF A01 CSCL 08/12

A new freezing mechanism, called segregation freezing, is proposed to explain the generation of the suction force that draws pore water up to the freezing surface of a growing ice lens. The segregation freezing temperature is derived by applying thermodynamics to a soil mechanics concept that distinguishes the effective pressure from the neutral pressure. The frost-heaving pressure is formulated in the solution of the differential equations of the simultaneous flow of heat and water, of which the segregation freezing temperature is one of the boundary conditions. GRA

**N78-31648#** Science Applications, Inc., La Jolla, Calif.
**ION CLOUD MODELING Final Report, 19 Apr. 1976 - 15 Feb. 1977**
Lewis M. Linson and David C. Baxter 11 Nov. 1977 96 p refs
(Contract DNA001-76-C-0274)
(AD-A055969; AD-E300216; SAI-77-918-LJ; DNA-4455F) Avail: NTIS HC A05/MF A01 CSCL 04/1

New quantitative procedures are developed for describing the deposition ion of clouds from high-altitude barium releases. The early-time expansion of the neutral vapor cloud via a snowplow model with diffusion added is developed. The inclusion of diffusion provides a description of the evolution of the neutral cloud into a Gaussian shape and provides the basis for a plausible explanation of why the apparent large size of photographic images of eary-time expanding neutral clouds are larger than can be explained by the release of reasonable amounts of neutral vapor. The subsequent deposition of ionization in the expanding neutral cloud results in an ion cloud that is substantially narrower than the neutral cloud consistent with a number of radar measurements. The influence of neutral winds and settling under gravity on the distribution of ionization along magnetic field lines and the descent through the atmosphere is treated analytically. It is shown that downward winds can delay the decrease in the peak ion concentration and that altitude-dependent winds are more effective in limiting the increase in length of the ion cloud. GRA

**N78-31649#** Clarkson Coll. of Technology, Potsdam, N.Y. Dept. of Civil and Environmental Engineering.

**COMPARISON OF SOIL MODULI OBTAINED FROM NON-DESTRUCTION DYNAMIC TESTING AND CONSTITUTIVE EQUATIONS Final Report, Jun. 1977 - May 1978**

William H. Highter 1978 43 p refs
(Grant AF-AFOSR-3364-77)
(AD-A055670; AFOSR-78-1056TR) Avail: NTIS HC A03/MF A01 CSCL 08/13

This report describes an effort to determine the degree of agreement between moduli of airfield granular base materials as measured by a non-destructive (vibratory) pavement evaluation procedure and as predicted from constitutive equations that relate moduli to states of stress induced in the granular material by aircraft loading. The results indicated that for the tensile state of stress that is induced by heavy aircraft loads, Young's modulus of the granular materials considered in the study was approximately inversely proportional to the square root of the state of stress. This could be postulated from the knowledge that for compressive state of stress, Young's modulus is approximately directly proportion to the square root of the state of stress. It was concluded that the moduli of the pavement granular base materials studied which were measured in the field in the Air Force non-destructive pavement evaluation procedure and then reduced to account for low strain levels are in agreement with the moduli determined from empirical constitutive equations. Author (GRA)

**N78-31650#** Geometrics, Inc., Sunnyvale, Calif.

**AERIAL GAMMA RAY AND MAGNETIC SURVEY, VAN HORN AND PECOS QUADRANGLES, TEXAS, VOLUME 1 Final Report**

Oct. 1977 138 p refs
(Contract EY-76-C-13-1664)
(GJBX-2-78-Vol-1) Avail: NTIS HC A07/MF A01

A high sensitivity, airborne radiometric and magnetic survey of portions of the Big Bend, Texas area was conducted. The project area comprising the Van Horn and Pecos 1:250,000 NTMS sheets, consists of approximately 16,400 square miles. A total of 6,666 line miles of high sensitivity radiometric and magnetic data were collected. Other data are presented which include corrected profiles of all radiometric variables, magnetic data, radar altimeter data, barometric altimeter data, air temperature and airborne Bismuth contributions. These data are presented in the form of strip charts, microfiche, and digital magnetic tapes containing raw spectral data, single record data, magnetic data, and statistical analysis results. In addition, computer generated anomaly maps along with interpretation maps are presented relating mapped geology to the collected radiometric data. ERA

**N78-31651#** Geological Survey, Denver, Colo.

**METHOD FOR OBTAINING CONFIDENCE-LIMIT VALUES FOR SEISMIC VALUES CALCULATED FROM VIBROSEIS DATA**

D. C. Muller and G. E. Brethauer Mar. 1978 13 p refs
(Contract EY-76-A-08-0474)
(USGS-474-255) Avail: NTIS HC A02/MF A01

A equation is derived to calculate the confidence limit values associated with seismic velocities calculated from time and distance data obtained using the Vibroseis method. This derived equation is a function of the uncertainty in the time measurement. Sources of timing uncertainty in the Vibroseis method are examined and estimates of the timing uncertainty are made. These estimates of the uncertainty in the time measurement are used to calculate the confidence limit values associated with calculated velocities. A monograph was constructed to provide quick approximation of these confidence limit values. The Vibroseis method is used in the nuclear weapons testing program to determine seismic velocities in various areas at the Nevada Test Site. These seismic velocities are used as parameters in ground motion and cavity growth model and as indicators of possible high acoustic impedance boundaries. ERA

**N78-31652#** California Univ., Livermore. Lawrence Livermore Lab.

**DEVELOPMENT OF A THREE-DIMENSIONAL MODEL OF THE ATMOSPHERIC BOUNDARY LAYER USING THE FINITE ELEMENT METHOD**

R. L. Lee and P. M. Gresho 22 Nov. 1977 24 p refs
(Contract W-7405-eng-48)
(UCRL-52366) Avail: NTIS HC A02/MF A01

The development of a model for the planetary boundary layer using the finite element technique is summarized. As an initial step, the finite element methodology is applied to a simpler version of the boundary layer equations given by the two dimensional constant property, incompressible conversion equations (Navier-Stokes equations). Solution procedures for both the steady-state and transient equations are discussed. For the transient problem, a variable time-step, trapezoid-rule algorithm with dynamic time-truncation error control is presented. The resulting system of nonlinear algebraic equations is solved by a Newton iteration procedure with a frontal solution scheme used for the linear set of equations. The need to develop a suitable linear equation solver, with respect to minimization of computer storage and execution costs, particularly for large (three-dimensional) finite element problems, is also discussed. ERA

**N78-31653#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Optoelektronik.

**LABORATORY MEASUREMENT OF THE SOLAR REMISSION FACTOR g SUB 1, 0 OF THE NO GAMMA BAND AT 2147 A FOR THE DETERMINATION OF THE DENSITY OF NITRIC OXIDE IN THE D-REGION OF THE IONOSPHERE M.S. Thesis - Tech. Univ. Berlin**

Joachim Laudam 12 Jul. 1977 111 p refs Partly in GERMAN and partly in ENGLISH Report will also be announced as translation (ESA-TT-517)
(DLR-FB-77-30) Avail: NTIS HC A06/MF A01; DFVLR, Cologne DM 47

For calculating the number density of nitric oxide from photometric rocket measurements in solar resonance emission the reemission factor of the ultraviolet gamma (1,0)-band was measured. There are four indirect calculations for this factor g sub 1,0 [ph/s M 4pi/sr] at 2147A from molecular parameters by Barth (1964 and 1966), Pearce (1969) and Witt (1973) which differ up to 100% from each other. Direct photon measurements confirmed the unpublished value of g = 0,00-000705 from Witt. It is suggested that the NO density measurements which are evaluated with different g-factors should be corrected. The study is a part of the German 1975-1976 rocket campaign for investigating the winter anomaly of radio wave absorption in the D-region which is mainly a consequence of NO ionization. Author (ESA)

**N78-31654#** Research Inst. of National Defence, Stockholm (Sweden).

**THE CAPABILITY OF A NETWORK OF SEISMOLOGICAL STATIONS TO DETECT EVENTS AND TO OBTAIN IDENTIFICATION PARAMETERS**

Eva Elvers Apr. 1978 32 p refs
(FOA-C-20231-T1) Avail: NTIS HC A03/MF A01

A model to estimate the capability to detect seismic events and to obtain identification parameters is studied, with emphasis on the importance of various parameters. The detection capability is expressed by the magnitude corresponding to a given probability that a minimum number of seismological stations detect an event. A similar expression is used for the capability to obtain identification parameters. Numerical results are studied for networks corresponding to fifty existing stations. The global variation of the magnitude level of about one unit is found to be due more to the uneven geographical distribution of stations than to their different individual capabilities. The results are comparatively insensitive to variations of parameters such as the station reliability and the variation in signal amplitudes. Author (ESA)

**N78-31655#** Research Inst. of National Defence, Stockholm (Sweden).

**SEISMIC MAGNITUDE ESTIMATES, WITH A MINIMUM NUMBER OF DETECTIONS**

Eva Elvers Apr. 1978 24 p refs
(FOA-C-20232-T1) Avail: NTIS HC A02/MF A01

The accuracies of the three methods of estimating seismic magnitudes are investigated, comparing in particular estimates

when a minimum number L of magnitudes have been obtained, for L equal to 1, 2, and 4. Station magnitudes and detection thresholds are simulated in a way corresponding to one rather heterogeneous network of stations and one more homogeneous. A maximum likelihood (ML) method, which is appropriate if events with less than L obtained magnitudes are excluded from estimation, is introduced. It is compared with the ordinary ML method and the conventional average of obtained magnitudes. The standard deviation is comparatively large, in particular for L = 1. The bias is instead closer to zero than for the two other methods, and it is the only one which is improved when L is increased. When L is increased the magnitude level also increases and the improvement in accuracy is smaller. Author (ESA)

**N78-31656#** Maryland Univ., College Park. Photomechanics Lab.

**TECHNIQUES FOR DYNAMIC FRACTURE TOUGHNESS MEASUREMENTS**

V. K. Der, D. C. Holloway, and T. Kobayashi Jan. 1978 60 p refs

(Grants NSF APR-73-07908; NSF APR-77-05171)

(PB-280083/7; NSF/RA-780045) Avail: NTIS HC A04/MF A01 CSCL 08G

The problem of experimentally determining K sub D as a function of crack velocity for brittle opaque materials in the range from K sub a to K sub b is addressed. A number of techniques were investigated for measuring the dynamic stress intensity factor. The first used a birefringent coating bonded to the material, dynamic reflective photoelasticity, and a high speed framing camera. The resulting isochromatic fringes (contours of constant principal stress differences) were analyzed to obtain K sub D. The second technique employed dynamic holographic interferometry from which isopachic fringes (contours of constant principal stress sums) were generated to determine K sub D values. A third technique referred to as the static equivalent method was used for estimating the dynamic stress intensity factor based on static measurements and correction factors for crack velocity effects and dynamic conditions. All were employed in the testing of a birefringent polyester material, Homalite 100, and the results were compared with those obtained using conventional dynamic photoelasticity. All three techniques are directly applicable to testing non-birefringent opaque materials, but only the static equivalent method was found to be useful for testing of rock. This method was applied to pink Westerly granite and an estimate of crack velocity vs. K sub D was obtained. GRA

**N78-31657#** National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.

**REEVALUATION OF MODIFIED MERCALLI INTENSITY SCALE FOR EARTHQUAKES USING DISTANCE AS DETERMINANT**

Rutlage J. Brazee Jan. 1978 173 p refs

(Contract AT(49-25)-1004)

(PB-281459/8; NOAA-TM-EDS-NGSDC-4; NOAA-78041227) Avail: NTIS HC A08/MF A01 CSCL 08K

An assumption is made that the attenuation of earthquake intensity parallels, or is representative of, the dissipation of earthquake energy and thus varies smoothly with distance outward from the center. A model embodying this concept is developed based on 400,000 earthquake intensity elements collected by the U.S. Coast and Geodetic Survey and its successor agencies during the period from 1928-1974. Curves for each intensity element of the modified Mercalli intensity scale of 1931 are then derived and fitted to the model. A revised intensity scale is assembled by reassigning the intensity elements in accordance with the results of the fitting process. GRA

**N78-31658#** California Univ., Davis. Water Resources Center.

**ENGINEERING AND PEDOLOGICAL PROPERTIES OF SOILS AS THEY AFFECT SOIL ERODIBILITY Technical Completion Report**

Michael J. Singer, John Blackard, Ernest Gillogley, and Kwdiah Arulanandan Jan. 1978 41 p refs Sponsored by Office of Water Resources and Technology

(PB-279856/9; CONTRIB-166; W78-06036; ISSN-0575-4941) Avail: NTIS HC A03/MF A01 CSCL 08M

Rainfall from a small laboratory simulator was used to evaluate the relative erodibilities of eight extensive California soils. The physical, chemical and engineering properties of these soils were determined and related to the relative erodibility of the soils. Critical shear stress, SAR, and dithionite iron content are three measureable properties of soils found to be important in determining their relative erodibility. The relationship between mulch cover percentage and sediment in surface runoff from simulated rainfall was also studied for oat, straw, oak leaf, and redwood litter mulches. GRA

**N78-31659#** Bureau of Mines, Spokane, Wash. Mining Research Center.

**INSTRUMENT TO MEASURE THE INITIAL DEFORMATION OF ROCK AROUND UNDERGROUND OPENINGS Report of Investigations, 1972 - 1977**

Michael J. Beus, Earl L. Phillips, and Galen G. Waddell 1978 51 p refs

(PB-279657/1; BM-RI-8275) Avail: NTIS HC A04/MF A01 CSCL 08I

A Tunnel Stress Relaxation gage (TSR) used to measure initial radial displacement around full-sized underground openings is described. Development of the TRS measurement system resulted in higher sensitivity, reliability, and versatility. Sensitivity was gained by employing a titanium alloy contilever in the transducer head, also permitting a deeper sensor location. Use of improved fabrication and testing methods such as stainless steel bellows and sputtering techniques, and use of an environmental chamber greatly increased overall reliability. A miniature data acquisition system (DAS) was interfaced directly to the transducer for increased versatility and containment entirely within a borehole. GRA

**N78-31660#** Inter-Union Commission on Geodynamics, Vancouver (British Columbia).

**GEODYNAMIC INTERNATIONAL-11**

Boulder, Colo. World Data Center A for Solid Earth Geophysics Jan. 1978 88 p refs

(PB-280747/7; SE-10; NOAA-78032402) Avail: NTIS HC A05/MF A01 CSCL 08G

The Geodynamics Project is an international program of research on the dynamics and dynamic history of the earth with emphasis on deep-seated foundations of geological phenomena. Investigations related to movements and deformations (past and present), of the lithosphere and all relevant properties of the earth's interior and especially any evidence for motions at depth are included. Plans for a Post-1980 successor to the International Geodynamics Program are explained. A revised list of Working Group and Study Group memberships is also included. The Geodynamics Project is presented in three parts: Accomplishments of the Program, Sources of Material, and Focus for a New Program. GRA

**N78-31661#** Advisory Group for Aerospace Research and Development, Paris (France).

**AN INTRODUCTION TO TURBULENCE IN GEOPHYSICS AND AIR-SEA INTERACTIONS**

Michel F. Coantic (CNRS, Marseille) Jul. 1978 252 p refs Presented as lecture series at California Univ., San Diego, spring quarter 1975

(AGARD-AG-232; ISBN-92-835-1284-7) Avail: NTIS HC A12/MF A01

The effects of turbulence and air-sea interactions upon the atmosphere and oceanographic environment are discussed along with the planetary boundary layer. Instantaneous equations, averaged equations, and the Boussinesq approximation are presented. The interaction between turbulence and radiation is also discussed. S.B.S.

## 47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

**N78-31662*#** City Univ. of New York. Dept. of Earth and Planetary Sciences.
**MONTHLY MEAN SIMULATION EXPERIMENTS WITH A COURSE-MESH GLOBAL ATMOSPHERIC MODEL**
Jerome Spar, Robert Klugman, Robert J. Lutz, and Jesus J. Notario Aug. 1978 57 p refs
(Grant NGR-33-013-086)
(NASA-CR-157574; Contrib-107) Avail: NTIS HC A04/MF A01 CSCL 04B

Substitution of observed monthly mean sea-surface temperatures (SSTs) as lower boundary conditions, in place of climatological SSTs, failed to improve the model simulations. While the impact of SST anomalies on the model output is greater at sea level than at upper levels the impact on the monthly mean simulations is not beneficial at any level. Shifts of one and two days in initialization time produced small, but non-trivial, changes in the model-generated monthly mean synoptic fields. No improvements in the mean simulations resulted from the use of either time-averaged initial data or re-initialization with time-averaged early model output. The noise level of the model, as determined from a multiple initial state perturbation experiment, was found to be generally low, but with a noisier response to initial state errors in high latitudes than the tropics. L.S.

**N78-31663*#** Science Applications, Inc., Huntsville, Ala.
**ANALYSIS OF VECTOR WIND CHANGE WITH RESPECT TO TIME FOR VANDENBERG AIR FORCE BASE, CALIFORNIA**
Stanley I. Adelfang Aug. 1978 427 p refs
(Contract NAS8-32226)
(NASA-CR-150776) Avail: NTIS HC A19/MF A01 CSCL 04B

A statistical analysis of the temporal variability of wind vectors at 1 km altitude intervals from 0 to 27 km altitude taken from a 10-year data sample of twice-daily rawinsode wind measurements over Vandenberg Air Force Base, California is presented. J.M.S.

**N78-31664*#** Science Applications, Inc., Huntsville, Ala.
**ANALYSIS OF WIND BIAS CHANGE WITH RESPECT TO TIME AT CAPE KENNEDY, FLORIDA, AND VANDENBERG AFB, CALIFORNIA**
Stanley I. Adelfang Aug. 1978 87 p refs
(Contract NAS8-32226)
(NASA-CR-150777) Avail: NTIS HC A05/MF A01 CSCL 04B

A statistical analysis is presented of the temporal variability of wind vectors at 1 km altitude intervals from 0 to 27 km altitude after applying a digital filter to the original wind profile data sample. Author

**N78-31665*#** Science Applications, Inc., Huntsville, Ala.
**ANALYSIS OF VECTOR WIND CHANGE WITH RESPECT TO TIME FOR CAPE KENNEDY, FLORIDA Technical Report, 15 Oct. 1976 - 14 Apr. 1977**
Stanley I. Adelfang Aug. 1978 760 p refs
(Contract NAS8-32226)
(NASA-CR-150779) Avail: NTIS HC A99/MF A01 CSCL 04B

Multivariate analysis was used to determine the joint distribution of the four variables represented by the components of the wind vector at an initial time and after a specified elapsed time is hypothesized to be quadravariate normal; the fourteen statistics of this distribution, calculated from 15 years of twice-daily rawinsonde data are presented by monthly reference periods for each month from 0 to 27 km. The hypotheses that the wind component changes with respect to time is univariate normal, that the joint distribution of wind component change with respect to time is univariate normal, that the joint distribution of wind component changes is bivariate normal, and that the modulus of vector wind change is Rayleigh are tested by comparison with observed distributions. Statistics of the conditional bivariate normal distributions of vector wind at a future time given the vector wind at an initial time are derived. Wind changes over time periods from 1 to 5 hours, calculated from Jimsphere data, are presented. Extension of the theoretical prediction (based on rawinsonde data) of wind component change standard deviation to time periods of 1 to 5 hours falls (with a few exceptions) within the 95 percentile confidence band of the population estimate obtained from the Jimsphere sample data. The joint distributions of wind change components, conditional wind components, and 1 km vector wind shear change components are illustrated by probability ellipses at the 95 percentile level. G.G.

**N78-31666#** Committee on Science and Technology (U. S. House).
**WEATHER MODIFICATION**
Washington GPO 1977 81 p refs Hearing before Subcomm. on the Environment and the Atmosphere of the Comm. on Sci. and Technol., 95th Congr., 1st Sess., 26 Oct. 1977
(GPO-20-025) Avail: Subcomm. on the Environment and the Atmosphere

Various weather modification programs were discussed, such as cloud seeding and research and development. The transnational aspects of weather modification are summarized, along with a discussion on the need for U.S. leadership in this field. J.A.M.

**N78-31667*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE GISS SOUNDING TEMPERATURE IMPACT TEST**
Milton Halem, Michael Ghil, Robert Atlas, Joel Susskind, and W. J. Quirk Jan. 1978 448 p refs
(NASA-TM-78063) Avail: NTIS HC A19/MF A01 CSCL 04B

The impact of DST 5 and DST 6 satellite sounding data on mid-range forecasting was studied. The GISS temmperature sounding technique, the GISS time-continuous four-dimensional assimilation procedure based on optimal statistical analysis, the GISS forecast model, and the verification techniques developed, including impact on local precipitation forecasts are described. It is found that the impact of sounding data was substantial and beneficial for the winter test period, Jan. 29 - Feb. 21. 1976. Forecasts started from initial state obtained with the aid of satellite data showed a mean improvement of about 4 points in the 48 and 772 hours Sub 1 scores as verified over North America and Europe. This corresponds to an 8 to 12 hour forecast improvement in the forecast range at 48 hours. An automated local precipitation forecast model applied to 128 cities in the United States showed on an average 15% improvement when satellite data was used for numerical forecasts. The improvement was 75% in the midwest. J.M.S.

**N78-31668#** Weapons Research Establishment, Salisbury (Australia).
**UPPER ATMOSPHERE WIND AND TEMPERATURE PROFILES OVER WOOMERA AT TWILIGHT**
K. H. Lloyd, C. H. Low, and R. I. MacLeod Dec. 1977 40 p refs
(WRE-TR-1921(W); AR-000-976) Avail: NTIS HC A03/MF A01

Results on wind and temperature profiles of the thermosphere determined by observing release of lithium, trimethyl aluminium vapor and aluminized grenades from sounding rockets launched at Woomera are presented. The drift and deformation of the trails are separated into large, medium, and small scale motions. Their interpretation in terms of tides, gravity waves, and turbulence is discussed. The high altitude wind velocity limit revealed especially interesting results. Temperature profiles, determined by comparing observed vapor cloud spectra with synthetic spectra, are presented. They are in close agreement with standard atmosphere profiles for the corresponding exospheric temperatures. J.M.S.

**N78-31669#** National Severe Storms Lab., Norman, Okla.
**GUST FRONT ANALYTICAL STUDY Final Report, Mar. 1976 - Dec. 1977**
R. C. Goff, J. T. Lee, and E. A. Brandes Dec. 1977 136 p refs
(Contract DOT-FA76WAI-622)
(AD-A056151; FAA-RD-77-119) Avail: NTIS HC A07/MF A01 CSCL 01/2

Strong wind changes and turbulence encountered by aircraft arriving or departing an airport constitute hazards to safe flight. Most serious encounters are thunderstorm outflow related. The gust front structure as observed by Doppler radar, standard

weather radar, a 461 m meteorologically instrumented tower, aircraft and other observations are presented. Gust front evolution as observed with a severe thunderstorm is shown. Turbulence and multiple surges are discussed. Author

**N78-31670#** Committee on Science and Technology (U. S. House).
**NATIONAL CLIMATE PROGRAM**
Washington GPO 1977 267 p refs Hearings before Subcomm. on the Environment and the Atmosphere of the Comm. on Sci. and Technol., 85th Congr., 1st Sess., 4-6 Apr. 1977
(GPO-92-323) Avail: Subcomm. on the Environment and the Atmosphere

The impacts of unanticipated fluctuations in regional climate are assessed in terms of economics, energy, agriculture, and demography. Factors covered include: (1) basic understanding of the climate baseline and fluctuations to be expected; (2) reliable detection of climate fluctuations or large-scale climate change; (3) natural and manmade factors which cause climate changes; and (4) possible measures necessary for protection from effects of climate fluctuations and long-term change. J.M.S.

**N78-31671#** Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
**ATMOSPHERIC CONDITIONS AT THE HIGH ENERGY LASER SYSTEMS TEST FACILITY (HELSTF), WHITE SANDS MISSILE RANGE, NEW MEXICO 24 MARCH TO 8 APRIL 1977 Data Report**
C. Norton, D. Walters, G. Hoidale, J. Hines, and W. Hatch Jan. 1978 480 p
(DA Proj. 1L1-61102-B-53A)
(AD-A055028; ERADCOM/ASL-DR-0001) Avail: NTIS HC A21/MF A01 CSCL 04/2

A set of atmospheric surface, tower, rawinsonde, and aircraft measurements was made at the High Energy Laser Systems Test Facility area from 24 March through 8 April 1977 in support of adaptive optics design for the Navy High Energy Laser Project Manager. These measurements consisted of optical turbulence, wind, water vapor, particulate size distribution, inversion height, air and soil surface temperature, and net radiation. Presented in this data report are plots and selected tabular listings of the surface, tower, and rawinsonde data. The aircraft measurements of optical turbulence are included in an appendix. Author (GRA)

**N78-31672#** Florida State Univ., Tallahassee. Geophysical Fluid Dynamics Inst.
**CLIMATE SIMULATION Final Report**
Richard L. Pfeffer Mar. 1978 90 p refs
(Contracts N00014-76-C-0844; N00014-77-C-0265; Grant NOAA-04-6-1-158-44053)
(AD-A055857) Avail: NTIS HC A05/MF A01 CSCL 04/2

Rotating annulus experiments are described in which the imposed thermal forcing is varied periodically by means of cyclic variations of the cold inner-bath temperature. In the way of background, the results of conventional annulus experiments, in which the imposed temperature contrast is not varied, and of hysteresis experiments, in which the imposed temperature contrast is varied slowly enough to be considered quasi-static, are reviewed. It is found that, in the region of dimensionless parameter space in which our experiments were conducted, the flow configuration in conventional and hysteresis experiments is determinate in the sense that it depends only upon the point in dimensionless-parameter space at which the experiment is conducted and the direction from which this point is approached. The flow configuration in experiments in which the imposed temperature contrast is varied in a cyclic fashion is found to be indeterminate in the sense that it changes from one state to another sporadically and cannot be predicted solely as a function of 'season'.
Author (GRA)

**N78-31673#** Mission Research Corp., Santa Barbara, Calif.
**PHYSICALLY-BASED HIGH RESOLUTION SURFACE WIND AND TEMPERATURE ANALYSIS FOR EPAMS Final Report**
Joseph A. Ball and Steven A. Johnson Mar. 1978 290 p refs
(Contract DAEA18-77-C-0043)
(AD-A055861; MRC-R-7731-1-278; ERADCOM/ASL-CR-78-0043-1) Avail: NTIS HC A13/MF A01 CSCL 04/2

This report documents the theoretical basis, development, and computational structure of a numerical computer analysis routine incorporated in the US Army Experimental Prototype Automatic Meteorological System (EPAMS) for the estimation of surface layer wind fields at sub-mesoscale resolution (approx. 100 meters) over a limited area in broken topography. The geographically re-locatable analysis exploits detailed topographic information but requires only limited meteorological information. The physically-based analysis uses Gauss: Principle of Least Constraints for a variational adjustment of an initial estimated wind field in a single surface layer to conform with terrain structure, mass conservation, and buoyancy forces. Fields of surface air temperature are also produced. Initial meteorological input is obtained from the EPAMS data base by an automated analysis which is described in detail. The segmentation structure of the computational program levels is presented. Appendices provide user instructions, detailed algorithms, and example wind field estimates. Author (GRA)

**N78-31674#** Oak Ridge National Lab., Tenn. Computing Applications Dept.
**WNDROS: A PROGRAM FOR DISPLAYING WIND ROSE DATA**
E. C. Schlatter Mar. 1978 22 p
(Contract W-7405-eng-26)
(ORNL-CSD-TM-40) Avail: NTIS HC A02/MF A01

The FORTRAN 4 program WNDROS uses the computer graphics system DISSPLA to produce a wind rose plot. The plot indicates wind frequency at a site as a function of wind speed and direction as read from Star data listings of the Environmental Data Service, National Climatic Center, NOAA. Options are available which allow the user to control the final appearance of the plot. A program description, user's guide, a data sample, a finished plot, and FORTRAN and JCL listings are included. ERA

**N78-31675#** Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.
**STOCHASTIC MODELLING OF SITE WIND CHARACTERISTICS Final Report**
R. B. Corotis Sep. 1977 155 p refs
(Contract EY-76-S-06-2342)
(RLO-2342-77/2) Avail: NTIS HC A08/MF A01

Statistical analysis procedures and probability models that are applicable to wind energy conversion sites in general are developed. Special computer algorithms are used to study variances, fit probability distributions, analyze run duration, and determine correlation structure in the wind. A total of 20 one-hour or three-hour records are analyzed from sites in New England, Illinois, Montana, Kansas, Wyoming, and Texas in developing and testing the models. ERA

**N78-31676#** World Meteorological Organization, Geneva (Switzerland).
**WORLD WEATHER WATCH. THE ROLE OF SATELLITES IN WMO PROGRAMMES IN THE 1980S**
D. S. Johnson and I. P. Vetlov 1977 50 p
(WMO-494; WWW-PLR-36; ISBN-92-63-10494-8) Avail: NTIS HC A03/MF A01; WMO, Geneva Sw.Fr. 41

The development of satellites and the World Weather Watch is recalled and the main advances in the field of the interpretation and use of satellite data are enumerated. The hydrometeorological and geophysical parameters which could be determined by means of satellites are listed and the possibilities for meeting the requirements of the various programs by means of satellite observations are assessed. The merits and drawbacks of each type of satellite are discussed and the function of the satellites of the future system is described, including their use as a means of collecting and relaying routine observational data. The aims and principles of processing satellite data at global, regional and national level are formulated and a general scheme is given for routine satellite data from immediately after a measurement has been made until it becomes available for operational and research purposes. Use of satellite data examples are given and further uses of the information for analysis and issuing weather forecasts for hydrological, marine meteorological, and aeronauti-

cal meteorological interests are outlined. The principle of remote sensing of geophysical parameters from satellites and the existing requirements for measurements of these are described. The possibility of meeting these requirements by means of the satellite system in the 1980s is assessed. Author (ESA)

**N78-31677#** World Meteorological Organization, Geneva (Switzerland).
**PRESENT TECHNIQUES OF TROPICAL STORM SURGE PREDICTION**
1978 95 p refs
(WMO-500; MSA-13; ISBN-92-63-10500-6) Avail: NTIS HC A05/MF A01; WMO, Geneva Sw.Fr. 20

An up-to-date review of the storm-surge problem is presented beginning with the observational data needed and then explaining the characteristics of storm surges, the principles of their prediction by numerical techniques, and practical methods of prediction. Information on evaluating the risk of storm surges and the need for field surveys of the damage they have caused is also given. ESA

**N78-31678#** Royal Netherlands Meteorological Inst., De Bilt.
**METEOROLOGICAL AND OCEANOGRAPHIC OBSERVATIONS ON BOARD NETHERLANDS LIGHTVESSELS IN THE NORTH SEA, 1971**
1978 185 p In DUTCH and ENGLISH
(KNMI-141-23) Avail: NTIS HC A09/MF A01; Roy. Neth. Meteorol. Inst. DFL 17,50

North Sea meteorological and oceanographic observations during 1971 are presented in tabular form. Meteorological data includes air pressure and temperature, wet bulb temperature, sea temperature, amount and duration of precipitation and fog. Oceanographic data includes salinity, swell, and ocean currents. ESA

**N78-31679#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.
**NEW APPROXIMATION EQUATIONS FOR THE SATURATION PRESSURE OF WATER VAPOR AND FOR HUMIDITY PARAMETERS USED IN METEOROLOGY**
Werner Boegel 2 Dec. 1977 159 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-509)
(DLR-FB-77-52) Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 61,60

The Goff-Gratch formulation of the thermodynamic properties of moist air used by the World Meteorological Organization (WMO) as a basis for the calculation of humidity-parameters being extremely useful in meteorology but often too complicated for direct applications. New simplified approximation equations for the saturation pressure of water vapor in the pure phase as a function of temperature, for the corresponding inverse functions, and for some real gas correction factors are described. These equations are then used to establish methods for calculating the most important humidity parameters, e.g. dew point temperature, relative humidity, mixing ratio etc. These methods, consisting for the most part in simple formulae, are tailored to meteorological applications, without assuming ideal gases. Author (ESA)

## 48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

**N78-31680** North Carolina State Univ. at Raleigh
**A MODEL FOR THE ATMOSPHERICALLY FORCED CIRCULATION IN AN OCEAN BASIN Ph.D. Thesis**
Mohammed-Reza Bannazadeh-Mahani 1977 173 p
Avail: Univ. Microfilms Order No. 78-11573

A model for the circulation of the ocean in the northern hemisphere is studied in spherical coordinates. The flow is driven by a zonal wind stress and by heating, both of which vary meridionally. The lowest order of the heat balance is taken to be diffusive. The effects of advection on the temperature distribution are then calculated by using a perturbation method. The zeroth order temperature field gives an overall representation of the ocean thermocline. Associated with this field, there is a baroclinic eastward flow in the upper layer, with a weak westward return flow below. There is also a barotropic wind driven circulation with a clockwise subtropical gyre and a counterclockwise tropical gyre with an associated western boundary current. Dissert. Abstr.

**N78-31681#** National Oceanic and Atmospheric Administration, Washington, D. C. Office of Coastal Zone Management.
**MASSACHUSETTS COASTAL ZONE MANAGEMENT PROGRAM AND FINAL ENVIRONMENTAL IMPACT STATEMENT**
1978 449 p
Avail: NTIS HC A19/MF A01

The management of the natural resources is discussed. The resources include: coastal hazards, visual, cultural, and historic environments; ports and harbors; fishing; recreation; and energy facilities. Economic factors and conflicting interests are considered along with an improved enforcement of existing laws, and the protection of wild life habitats. Participation in the program by local, state, and federal agencies is outlined. S.B.S.

**N78-31682#** Rhode Island Univ., Kingston. Graduate School of Oceanography.
**SUPPLEMENTAL DATA REPORT ON INVESTIGATIONS OF MARINE DISSOLVED ORGANIC MATTER PROTONATION EQUILIBRIA**
Douglas L. Huizenga May 1978 103 p
(Contract N00014-76-C-0226)
(AD-A055157; URI/GSO-REF-78-1) Avail: NTIS HC A06/MF A01 CSCL 08/10

This data report is a supplemental record of data and calculations related to the author's M.S. thesis' :Protonation Characteristics of the Dissolved Organic Matter in Seawater' (University of Rhode Island, 1977). The individual fraction titration data, calculated organic matter titration curves, model parameters, and copies of computer programs are presented. GRA

**N78-31683#** Texas A&M Univ., College Station. Dept. of Oceanography.
**DEEP OCEAN MINING ENVIRONMENTAL STUDY, DOMES. UNPUBLISHED MANUSCRIPT NO. 12: LAGRANGIAN DIFFUSION PARAMETERS IN THE SURFACE WATER OF THE TROPICAL NORTH PACIFIC OCEAN**
T. Ichiye 1977 15 p refs Sponsored by NOAA Pacific Marine Environ. Lab.
(PB-281388/9; NOAA-77101712) Avail: NTIS HC A02/MF A01 CSCL 08C

Richardson-type drifters data from the Pacific north equatorial counter current region between 125 degrees and 155 degrees W and between 4 degrees and 10 degrees N are analyzed. The drifter data lead to reasonable values of lateral eddy diffusivities. GRA

**N78-31684#** National Ocean Survey, Rockville, Md.
**NATIONAL OCEAN SURVEY, FISCAL YEAR 1977**
Mar. 1978 85 p
(PB-281390/5; NOAA-78041207) Avail: NTIS HC A05/MF A01 CSCL 08B

A brief account of the activities during Fiscal Year 1977 (October 1976 through September 1977) and the interim quarter FY 7T (July, August, September 1976) is given. Areas of major national concern include marine boundaries, ocean dumping, sea-floor probes, geodetic studies, and congested airways control. The following departments report their activities: Office of National Geodetic Survey, Office of Marine Surveys and Maps, Office of Aeronautical Charting and Cartography, Office of Program Development and Management, Office of Marine Technology, Office of Fleet Operations, Atlantic Marine Center, and Pacific Marine Center. GRA

**N78-31685#** Maryland Univ., Solomons. Chesapeake Biological Lab.
**RESULTS OF BENTHIC STUDIES AT CALVERT CLIFFS Interim Report, Aug. 1976 - Mar. 1977**
A. F. Holland, K. Kaumeyer, N. K. Mountford, M. Hiegel, and J.

A. Mihursky Jul. 1977 384 p refs Sponsored by the Maryland Dept. of Natural Resources Prepared in cooperation with Martin Marietta Corp., Baltimore
(PB-280279/1; UMCEES-Ref-77-91-CBL; PPSP/MMC/CC-77/1) Avail: NTIS HC A17/MF A01 CSCL 08A

Three macrofaunal communities (i.e., 10-ft sand community, 30-ft mud community, and 20-ft shell community) with statistically different structural characteristics were identified from the Calvert Cliffs region of the Chesapeake Bay. Each community was restricted to a specific substrate type and their structure varied seasonally in a predictable manner with natural changes in temperature and dissolved oxygen regime. Because of these characteristics the structure of macrofaunal communities at Calvert Cliffs is well-suited to be used as an indicator of gradual environmental perturbations such as would result during power plant operations. However, before a macrofaunal community study will be useful to a vigorous assessment scheme at Calvert Cliffs, natural variation in community structure will have to be separated from power plant induced changes. GRA

**N78-31686#** National Oceanic and Atmospheric Administration, Seattle, Wash. Pacific Marine Environmental Lab.
**OBSERVATIONS OF THE ANTARCTIC POLAR FRONT BY A MOORED ARRAY DURING FDRAKE-76**
Stanley P. Hayes and Walter F. Zenk (Kiel Univ., West Ger.) Sep. 1977 50 p refs
(PB-281460/6; NOAA-TR-ERL-390; PMEL-28; NOAA-78041218) Avail: NTIS HC A03/MF A01 CSCL 08J

Moored current meter and thermistor chain measurements recorded for 28 days near the Antarctic polar frontal zone in the central Drake Passage are presented. The data indicate that the temperature distribution in the depth interval 200-350 m was essentially bimodal and that it changed with the position of the front. When the mooring was north of the front, the water was warm and nearly homogeneous. When it was south of the front, the temperature decreased and stratification increased. These results indicate the effectiveness of moored temperature sensors as monitors of frontal movement. GRA

**N78-31687#** National Marine Fisheries Service, Seattle, Wash.
**DEEP OCEAN MINING ENVIRONMENTAL STUDY (DOMES). UNPUBLISHED MANUSCRIPT NUMBER 20. DATA REPORT: TRACE METALS - DOMES SAMPLES**
Alice S. Hall, Clifford R. Houle, F. M. Teeny, and E. J. Gauglitz, Jr. Sep. 1977 156 p
(PB-281098/4; NOAA-78022703) Avail: NTIS HC A08/MF A01 CSCL 08J

Fish samples, micronekton, and zooplankton were ground and thoroughly mixed prior to subsampling. Five to 10 gram analytical samples were dried and charred under infrared heat lamps prior to ashing in a muffle furnace at a maximum temperature of 450 C. The ash was dissolved and analyzed by aspiration of the sample solution into an inductively coupled argon plasma emission spectrometer. Standardization of this instrument was accomplished by the use of spectrochemically pure elemental standards approximating the chemical composition of the sample matrix. GRA

**N78-31688#** Gulf South Research Inst., Baton Rouge, La.
**COASTAL MARSH PRODUCTIVITY: A BIBLIOGRAPHY**
J. D. Bagur Oct. 1977 315 p
(Contract DI-14-16-0008-2113)
(PB-281089/3; FWS/OBS-77/3) Avail: NTIS HC A14/MF A01 CSCL 08A

The value of the marshes is shown in several ways: habitat for wildlife species, producer of nutrients, nursery areas, and protected rearing areas for juveniles. The bibliography contains 401 references with abstracts grouped into five major sections: The Marsh Environment (Marshes and Marsh Vegetation); Primary Productivity of Coastal Marsh Plants; Detritus in the Food Chain; Marsh Estuaries as Fish Havens and Marsh as Habitat and Feeding Grounds. Author, species, and subject indexes are provided. GRA

# 51 LIFE SCIENCES (GENERAL)

Includes genetics.

**N78-31689** California Univ., Berkeley.
**THE EFFECT OF HIGH ALTITUDE ON PYRIDINE NUCLEOTIDES AND ADENOSINE PHOSPHATES IN THE LIVER OF THE RAT Ph.D. Thesis**
Ronald Dawson Reed 1977 144 p
Avail: Univ. Microfilms Order No. 7812746

The effects of hypoxia on cellular oxidation-reduction (redox) status energy status in rat liver tissue were investigated. Alterations in redox status were observed by a direct measurement of total cellular pyridine nucleotides--nicotinamide adenine dinucleotides and nicotinamide adenine dinucleotide phosphates and subsequent calculation of their redox ratios. Additional examination of cytoplasmic redox status was made through a determination of the concentrations of lactate, pyruvate, alpha-glycerophosphate, and dihydroxyacetone phosphate. Phosphate bond energy status was examined by analyses of adenosine triphosphate, adenosine diphosphate and adenosine monophosphate. The results emphasize the importance of exygen as the ultimate electron acceptor of the cell. With hypoxia the partial pressure of oxygen falls at the cellular level, resulting in an increased redox status and a decreased energy status. Dissert. Abstr.

**N78-31690*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DIGITAL ENHANCEMENT OF COMPUTERIZED AXIAL TOMOGRAMS**
Ernest Roberts, Jr. 1978 6 p refs Presented at the 5th Ann. Computers in Cardiology Conf., Stanford, Calif., 12-14 Sep. 1978; cosponsored by IEEE, NIH, and Stanford Univ. School of Med.
(NASA-TM-78974; E-9748) Avail: NTIS HC A02/MF A01 CSCL 06E

A systematic evaluation was conducted of certain digital image enhancement techniques performed in image space. Three types of images were used, computer generated phantoms, tomograms of a synthetic phantom, and axial tomograms of human anatomy containing images of lesions, artificially introduced into the tomograms. Several types of smoothing, sharpening, and histogram modification were explored. It was concluded that the most useful enhancement techniques are a selective smoothing of singular picture elements, combined with contrast manipulation. The most useful tool in applying these techniques is the gray-scale histogram. L.S.

**N78-31691*#** Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Biology.
**THE 70 S MONOSOME ACCUMULATION AND IN VITRO INITIATION COMPLEX FORMATION BY ESCHERICHIA COLI RIBOSOMES AT 5 C Ph.D. Thesis**
Robert J. Broeze and Daniel H. Pope [1978] 33 p refs
(Grant NsG-7345)
(NASA-CR-157591) Avail: NTIS HC A03/MF A01 CSCL 06C

The inhibition of translation which is observed after shifting Escherichia coli to low temperature was investigated. 70 S ribosomes were isolated from E. coli 8 hours after a shift to 5 C synthesized protein in the absence of added mRNA (i.e., endogenous protein synthesis by 70 S monosomes) at a rate which was three times greater than the rate of endogenous protein synthesis by 70 S ribosomes which were isolated at the time of the shift to 5 C. Calculations based on the rates of endogenous protein synthesis and polyphenylalanine synthesis indicate that 70 S monosomes comprise only 0.1% of the total E. coli 70 S ribosome population after 8 hours at 5 c. Experiments designed to test initiation complex formation on ApUpG or formaldehyde treated MS-2 viral RNA demonstrated that, although the rate of formation of 30 S initiation complexes was not inhibited, the rate of formation of active 70 S initiation complexes, able to react with puromycin, was inhibited to a great extent at 5 C. A model depicting the effects of low temperature on the E. coli translation system is proposed. Author

**N78-31692#** Professional Staff Association of Los Angeles County/-Univ. of Southern California Medical Center, Los Angeles.
**BEHAVIOR, ECOLOGY AND TOXICITY OF VENOMOUS MARINE FISHES Final Technical Report, 1 Oct. 1975 - 31 Dec. 1977**
Findlay E. Russell 31 Dec. 1977 10 p refs
(Contract N00014-76-C-0254)
(AD-A054925) Avail: NTIS HC A02/MF A01 CSCL 06/20

The writer has been studying the general biology of certain venomous marine fishes of nuisance importance to Navy personnel; the chemistry and electron microscope appearance of the skin of certain fishes recently found to be toxic; the ultrastructure of the venom apparatus of the stingrays and scorpion fishes; the chemistry and pharmacology of stingray and scorpionfish venom. Work on the chemistry of California scorpion fish venom indicate that sulfhydryl groups are required for the lethal activity of the venom. Cystine and reduced glutathione appear to have no significant effect on this activity until several days have passed. Cleland's reagent, an effective sulfhydryl reagent, stabilizes the lethal activity. The lethal activity is sensitive to heat, oxidizing agents and extremes of concentration and pH. The venom contains nonsignificant amounts of proteolytic and phosphodiesterase activity. When the crude venom is fractionated by gel filtration chromatography, the lethal activity is associated with proteins having a molecular weight of more than 40,000 and would seem to have a molecular weight of less than 2,000,000. Following separation on Sephadex G-200, the semi-purified lethal fraction has an IV LD sub 50 in mice of 0.9 mg/protein/kg body weight, while the LD sub 50 of the crude venom is 2.6 mg/protein/kg. GRA

**N78-31693#** National Technical Information Service, Springfield, Va.
**BIONICS. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1970 - Apr. 1978**
George W. Reimherr Jun. 1978 118 p Supersedes NTIS/PS-77/0413; NTIS/PS-76/0370; NTIS/PS-75/396; COM-73-11718
(NTIS/PS-78/0550/0; NTIS/PS-77/0413; NTIS/PS-76/0370; NTIS/PS-75/396; COM-73-11718) Avail: NTIS HC $28.00/MF $28.00 CSCL 06D

Recent advances in visual information processing, electronic models of nerve cells, and biological sonar systems are discussed in these citations. Theory and applications are included, along with computerized simulation and signal processing. Electrophysiology and modelling of the central nervous system are also included. (This updated bibliography contains 112 abstracts, 17 of which are new entries to the previous edition.) GRA

**N78-31694#** Joint Publications Research Service, Arlington, Va.
**TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: BIOMEDICAL AND BEHAVIORAL SCIENCES, NO. 35**
14 Jul. 1978 120 p refs Transl. into ENGLISH from various Russian documents
(JPRS-71467) Copyright. Avail: NTIS HC A06/MF A01

Articles are presented dealing with the development of the space suit and the presence of electroreceptors in man. For individual titles, see N78-31695 through N78-31696.

**N78-31695#** Joint Publications Research Service, Arlington, Va.
**EVOLUTION OF THE SPACE SUIT c54**
V. B. Malkin and I. N. Chernyakov *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 35 (JPRS-71467) 14 Jul. 1978 p 1-7 Transl. into ENGLISH from Zdorovye (Moscow), no. 4, 1978 p 7-8 (For primary document see N78-31694 22-51)
Copyright. Avail: NTIS HC A06/MF A01

Features of the space suit developed for use in the spacecraft and during extravehicular activity are described. These include: (1) permits normal respiration; (2) maintains oxygen pressure in the lungs; (3) regeneration of oxygen and absorption of carbon dioxide; (4) flexibility; and (5) heat exchange through ventilation and water cooling systems. J.M.S.

**N78-31696#** Joint Publications Research Service, Arlington, Va.
**ELECTRORECEPTORS IN MAN AND OTHER ANIMALS c52**
O. B. Ilinskiy *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 35 (JPRS-71467) 14 Jul. 1978 p 56-59 refs Transl. into ENGLISH from Zdorovye (Moscow), no. 4, 1978 p 12-13 (For primary document see N78-31694 22-51)
Copyright. Avail: NTIS HC A06/MF A01

The electroreceptor systems of fish, specifically the shark and the ray, are examined. It is shown that vertebrate animals with electroreceptor systems perceive electrical and magnetic stimuli in the environment. It is hypothesized that man has some sort of specialized receptor structures capable of perceiving electrical and magnetic stimuli in the environment. J.M.S.

**N78-31697#** Joint Publications Research Service, Arlington, Va.
**TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: BIOMEDICAL AND BEHAVIORAL SCIENCES, NO. 39**
28 Jul. 1978 96 p refs Transl. into ENGLISH from various Russian journals
(JPRS-71569) Copyright. Avail: NTIS HC A05/MF A01

Articles are presented dealing with genetics, industrial toxicology, bioinstrumentation, and radiology. For individual titles, see N78-31698 through N78-31704.

**N78-31698#** Joint Publications Research Service, Arlington, Va.
**GENETICS OF MICROORGANISMS AND MEDICINE c52**
V. D. Timakov and N. F. Gamaleya *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 25-40 refs Transl. into ENGLISH from Zh. Obshch. Biol. (Moscow), no. 3, 1978 p 335-346 Presented at the All-Union Soc. of Geneticists and Breeders, Leningrad, May 1977 (For primary document see N78-31697 22-51)
Copyright. Avail: NTIS HC A05/MF A01

Medical aspects of genetic research pursued on microorganisms are discussed. Data are submitted on genetic control of virulence and toxic production of bacteria. Genetic and biochemical research dealing with catabolite repression and mechanisms of repair of DNA injuries induced by radiation and chemical agents are analyzed. The role of genetics of microorganisms in development of general genetics and formation of the new molecular genetics direction in biology is discussed. The objectives of research on genetics of microorganisms of basic importance to both medicine and learning general biological laws are formulated. J.M.S.

**N78-31699#** Joint Publications Research Service, Arlington, Va.
**SOME PRESSING PROBLEMS OF GENETICS c52**
N. P. Dubinin *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 41-52 refs Transl. into ENGLISH from Zh. Obshch. Biol. (Moscow), no. 3, 1978 p 347-356 Presented at the 3d Congr. of the All-Union Soc. of Geneticists and Breeders, Leningrad, May 1977 (For primary document see N78-31697 22-51)
Copyright. Avail: NTIS HC A05/MF A01

The main advances and tasks confronting the scientific direction of genetics are formulated. The role of genetics in mobilizing food and raw material resources, genetics and medicine, the problem of environmental mutagens, social and biological aspects of the problem of man, and genetic engineering are covered. J.M.S.

**N78-31700#** Joint Publications Research Service, Arlington, Va.
**THE ROLE OF TECHNOLOGICAL AND LAY-OUT FACTORS, AS WELL AS CLIMATE, IN FORMATION OF THE AIR BASIN IN THE REGION OF CHEMICAL PLANTS c45**
A. P. Mikhayluts *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 53-59 refs Transl. into ENGLISH from Gig. Tr. (Moscow), no. 6, 1978 p 6-11 (For primary document see N78-31697 22-51)
Copyright. Avail: NTIS HC A05/MF A01

Methods utilized to reduce air pollution in the vicinity of chemical plants are examined. Technological developments, plant

lay-out, and climate are among the factors considered. Conclusions are given. J.M.S.

**N78-31701#** Joint Publications Research Service, Arlington, Va.

**ON THE QUESTION OF RAPIDLY SETTING HYGIENIC STANDARDS FOR INDUSTRIAL SUBSTANCES WITH IRRITANT ACTION** **c45**

N. G. Ivanov *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 60-63 refs Transl. into ENGLISH from Gig. Tr. (Moscow), no. 6, 1978 p 50-52 (For primary document see N78-31697 22-51)

Copyright. Avail: NTIS HC A05/MF A01

Correlations between the parameters of toxicity of industrial irritant toxic agents were established. Equations of multiple regression were formulated to calculate the maximum permissible concentrations of such agents in work zone air. A method was developed for rapid setting of hygienic standards for specific irritants, based on determination of C150, Lim sub ac, Lim sub ir kr, and Lim sub ir man. The time required to substantiate the maximum permissible concentrations of toxic substances in work zone air is reduced to 1.5-2 months with the proposed method. The results of experimental studies and calculations made with the proposed equations revealed that the proposed rapid method of setting hygienic standards for industrial toxic agents with irritant action is of satisfactory precision. J.M.S.

**N78-31702#** Joint Publications Research Service, Arlington, Va.

**A VARIANT OF PORTABLE SINGLE-CHANNEL BIORADIOTELEMETRY SYSTEM** **c52**

A. A. Shaptala, V. S. Sautkin, and V. V. Zabrodin *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 64-66 ref Transl. into ENGLISH from Gig. Tr. (Moscow), no. 6, 1978 p 56-58 (For primary document see N78-31697 22-51)

Copyright. Avail: NTIS HC A05/MF A01

Development of a relatively simple, reliable, single-channel system for FM-FM dynamic radiotelemetry of electrophysiological and nonelectrophysiological indexes is described. The system is limited to the frequency band of 0.2-300 Hz and amplitude of 0.0-10 mV. J.M.S.

**N78-31703#** Joint Publications Research Service, Arlington, Va.

**A METHOD OF RECORDING HEAT PARAMETERS OF DIVERS DURING WORK** **c54**

A. V. Sterlikov *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 67-69 Transl. into ENGLISH from Gig. Tr. (Moscow), no. 6, 1978 p 55-56 (For primary document see N78-31697 22-51)

Copyright. Avail: NTIS HC A05/MF A01

A device designed to permit successive transmission of data from 12 temperature sensors over only two wires, to avoid inconveniences in recording the parameters of a diver's thermal status, is described. The communicating device was used to take information from the sensors of skin temperature, sublingual temperature, temperature under the clothing, and ambient water temperature when pursuing studies of heat exchange when a diver is working under water. J.M.S.

**N78-31704#** Joint Publications Research Service, Arlington, Va.

**DEPENDENCE OF THE REACTION OF THE HUMAN NERVOUS SYSTEM ON THE DISTRIBUTION OF ABSORBED DOSES OF IONIZING RADIATION** **c52**

G. I. Kirsanova *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 P 76-84 refs Transl. into ENGLISH from Med. Radiol. (Moscow), no. 5, 1978 p 3-8 (For primary document see N78-31697 22-51)

Copyright. Avail: NTIS HC A05/MF A01

The nervous system was found to react in unique ways in observations of large occupational groups working in the presence of chronic radiation and characterized by different distributions of absorbed energy in the human body. Concrete cases of acute radiation exposure are used to demonstrate the typical clinical manifestations of the affliction of the nervous system depending on distribution of absorbed energy in brain tissues. J.M.S.

**N78-31705#** Joint Publications Research Service, Arlington, Va.

**TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: BIOMEDICAL AND BEHAVIORAL SCIENCES, NO. 40. EFFECTS ON NONIONIZING ELECTROMAGNETIC RADIATION**

1 Aug. 1978 51 p refs Transl. into ENGLISH from various Russian journals

(JPRS-71595) Copyright. Avail: NTIS HC A04/MF A01

Articles are presented concerning the biological effects of electromagnetic fields, steady magnetic fields, and electric fields. Topics discussed include: Coagulation of blood and tissues of the cardiovascular system after prolonged exposure to electromagnetic fields; influence of superhigh intensity steady magnetic fields on bone marrow cells; ecological effects of high voltage electric power lines; and survey of research on biological effects of magnetic fields. For individual titles, see N78-31706 through N78-31709.

**N78-31706#** Joint Publications Research Service, Arlington, Va.

**COAGULATIVE PROPERTIES OF BLOOD AND TISSUES OF THE CARDIOVASCULAR SYSTEM IN EXPOSURE TO ELECTROMAGNETIC FIELDS** **c52**

V. Ye. Kuksinskiy *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 40 (JPRS-71595) 1 Aug. 1978 p 1-7 refs Transl. into ENGLISH from Kardiologiya (Moscow), no. 3, 1978 p 107-110 (For primary document see N78-31705 22-51)

Copyright. Avail: NTIS HC A04/MF A01

Albino rats were exposed to prolonged action of a low frequency electromagnetic field on recalcification time, tolerance of plasma for heparin, consumption of prothrombin, thrombin time, and fibrinolysis. Results are presented in a table. It is concluded that: (1) a phase nature of changes in the coagulation properties of the heart and aorta is observed; (2) irradiation of rats by an electromagnetic field for 8 days is accompanied by an increase in the coagulating and fibrinolytic activity of the blood with a simultaneous inhibition of the thromboplastic compounds of the heart and cardiac wall; and (3) an increase in length of exposure to 20 days results in inactivation of both the tissue and the plasma factors in blood coagulation and fibrinolysis. J.M.S.

**N78-31707#** Joint Publications Research Service, Arlington, Va.

**PROLIFERATION OF BONE MARROW CELLS UNDER THE INFLUENCE OF SUPERHIGH INTENSITY STEADY MAGNETIC FIELDS**

A. D. Strzhizhovskiy and G. V. Galaktionova *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 40 (JPRS-71595) 1 Aug. 1978 p 8-12 refs Transl. into ENGLISH from Tsitologiya (Leningrad), no. 6, 1978 p 717-720 (For primary document see N78-31705 22-51)

Copyright. Avail: NTIS HC A04/MF A01

The effects of 9.9-42.4 kOe steady magnetic fields (SMF) with an intensity gradient of 0.2-3.5 kOe/cm for 0.5-24 h on mitotic activity and quantity of bone marrow cells in mice was studied. It was demonstrated that brief exposure stimulates mitotic activity and long exposure depresses it; the severity of depression was directly related to intensity and intensity gradient of SMF. The longer the exposure and the higher the intensity of SMF, the slower the rate of restoration of mitotic index to the base level after exposure. In those cases where inhibition of mitotic activity is the most marked, a decrease in number of bone marrow cells was observed. No increase in incidence of aberrant mitoses in bone marrow cells was observed under the influence of SMF. J.M.S.

**N78-31708#** Joint Publications Research Service, Arlington, Va.

**POSSIBILITY OF ATTENUATING THE ECOLOGICAL EFFECTS OF ALTERNATING CURRENT POWER LINES AS A RESULT OF NEW DESIGNS AND CIRCUIT CHANGES**

V. M. Postolatiy and S. P. Putyatin *In its* Transl. on USSR Sci.

and Technol.: Biomed. and Behavioral Sci., No. 40 (JPRS-71595) 1 Aug. 1978 p 13-22 refs Transl. into ENGLISH from Izv. Akad. Nauk Moldavsk. SSR, Ser. Friz.-Tekh. i Mat. Nauk (Kishinev), no. 1, 1978 p 73-79 (For primary document see N78-31705 22-51)
Copyright. Avail: NTIS HC A04/MF A01

The possibility of lowering the ecological effects of single and double circuit alternating current electric power lines by means of approximating phases is discussed. With respect to multicircuit electric power lines, reduction of interphase and intercircuit distances is considered in combination with a change in phase shift of triple phase voltage systems applied to the circuits, with different combinations of magnitude. J.M.S.

**N78-31709#** Joint Publications Research Service, Arlington, Va.
**MAGNET EFFECTS IN BIOLOGY**
M. M. Vilenchik *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 40 (JPRS-71595) 1 Aug. 1978 p 23-48 refs Transl. into ENGLISH from Usp. Sovrem. Biol. (Moscow), v. 63, no. 1, 1967 p 54-71 (For primary document see N78-31705 22-51)
Copyright. Avail: NTIS HC A04/MF A01

Research on the biological effects of steady magnetic fields is surveyed. Topics covered include: directional effects; changes in reflex activity; magnetotropism; functional and morphological changes; changes in radiation effects; inhibition of tumor growth; and genetic effects. It is noted that research has focused on the biological effects of steady magnetic fields in animals, however, several experimental investigations into the effects of magnetic fields on physiological processes in the human body are cited. J.M.S.

## 52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

**N78-31710** Stanford Univ., Calif.
**DIAGNOSTIC IMPROVEMENTS IN MEDICAL ULTRASONIC IMAGING SYSTEMS Ph.D. Thesis**
David Henry Dameron 1978 155 p
Avail: Univ. Microfilms Order No. 7814165

Four separate topics are discussed, all related to improvements in medical ultrasonic imaging systems. The first two, concerning acoustic lens and reflector systems are very similar, the former using refraction, the latter reflection in order to produce pulse-echo images. The third topic, magnetostrictive imaging systems, is a new emissive ultrasonic imaging technique which uses electromagnetic waves for transmission and normal ultrasonic pulse-echo systems for reception. The last topic is a description of a tissue model where the spatial parameters vary continuously, instead of being piece-wise constant. Dissert. Abstr.

**N78-31711** Minnesota Univ., Minneapolis.
**FACTORS DETERMINING MAXIMAL EXPIRATORY FLOWS IN THE HUMAN LUNG Ph.D. Thesis**
Ephraim Bar-Yishay 1978 229 p
Avail: Univ. Microfilms Order No. 78-13378

Expiratory flow from the lung increases with increasing effort up to a maximum beyond which flow is independent of driving pressure. Maximal expiratory flow is thought to depend primarily on the mechanical properties of the airways, the flow resistance in the lung periphery, and lung tissue viscous resistance. The results are presented of an experimental examination of some of the properties of the human lung which are significant in determining maximal expiratory flow; namely the geometry and compliance of the central airways and dynamic lung recoil. In addition, a computational model for maximal expiratory flow which incorporates the experimental data is presented. Flow predictions based on the observed dynamic pressure-volume relationship are found to be in better agreement with the actual flows than those predicted using the static pressure-volume relationship. Dissert. Abstr.

**N78-31712*+** National Aeronautics and Space Administration, Washington, D. C.
**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES. SUPPLEMENT 183**
Aug. 1978 86 p refs
(NASA-SP-7011(183)) Avail: NTIS HC E03 CSCL 06E

This bibliography lists 273 reports, articles, and other documents introduced into the NASA scientific and technical information system in July 1978. Author

**N78-31713*#** Oregon Univ. Health Sciences Center, Portland. Dept. of Neurology.
**ANALYTICAL STUDY OF ELECTROPHORETIC CHARACTERIZATION OF KIDNEY CELLS Final Report, 6 Aug. 1976 - 5 Jun. 1978**
Robert J. Knox 16 Aug. 1978 67 p refs
(Contract NAS8-32162)
(NASA-CR-150790) Avail: NTIS HC A04/MF A01 CSCL 06A

Embryonic kidney cells were studied as a follow-up to the MA-011 Electrophoresis Technology Experiment which was conducted during the Apollo Soyuz Test Project (ASTP). The postflight analysis of the performance of the ASTP zone electrophoresis experiment involving embryonic kidney cells is reported. The feasibility of producing standard particles for electrophoresis was also studied. This work was undertaken in response to a need for standardization of methods for producing, calibrating, and storing electrophoretic particle standards which could be employed in performance tests of various types of electrophoresis equipment. Promising procedures were tested for their suitability in the production of standard test particles from red blood cells. J.M.S.

**N78-31714*#** Pennsylvania Univ., Philadelphia. Inst. for Environmental Medicine.
**WORK CAPABILITY AND PHYSIOLOGICAL EFFECTS PREDICTIVE STUDIES. 4: IN He-O2 EXCURSIONS TO PRESSURES OF 400- 800- 1200- AND 1600 FEET OF SEA WATER**
C. J. Lambertsen, ed., R. Gelfand, ed., J. M. Clark, ed., and M. E. Fletcher, ed. 1978 624 p refs
(Grant NsG-9011; Contracts N00014-67-A-0216-0026; N00014-67-A-0216-0037; N00014-75-C-1124; Grant HC-08899-11)
(NASA-CR-157571; Rept-78-1) Avail: NTIS HC A99/MF A01 CSCL 06E

Experiments which exposed men in chambers, breathing helium with oxygen, to progressive increases of pressure equivalent to 400-800-1200-1600 feet of sea water (fsw) were conducted. Rates of compression and exposure to stable high pressure. Goals included: 1) determination of the specific character and time course of onset of physiological and performance decrements during the intentionally rapid compressions, and determination of rates of adaptation on reaching stable elevated pressure; 2) investigation of accelerated methods for decompression in deep saturation excursion diving; and 3) determination of competence in practical work performed in water at pressures equivalent to the extreme diving depths of 1200 and 1600 fsw. Author

**N78-31715#** Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md.
**TOXICOLOGICAL EVALUATION OF PYRETHRINS FOGGING CONCENTRATE (TRADE NAME) STUDY NO. 51-1309-78 Final Report, Jul. 1976 - Jun. 1977**
Joseph A. Macko, Jr., LeRoy W. Metker, Perry J. Kurtz, and K. Clark Swentzel Jun. 1977 49 p refs
(AD-A055088; USAEHA-51-1309-78) Avail: NTIS HC A03/MF A01 CSCL 06/20

A toxicological evaluation of Pyrethrins Fogging Concentrate and its ingredients was conducted by this Agency. One and four hour single inhalation aerosol exposures were performed on rats and rabbits. Transient toxic signs (red exudate around the eyes and nose) were observed in animals exposed to APCO 467 for 1 hour at 4.7 mg/1 and for 4 hours at 1.3 mg/1, and also to Pyrocide for 4 hours at 1.4 mg/1. No histological lesions attributable to the inhalation of Pyrethrins Fogging Concentrate or its ingredients were detected in rats necropsied 14 days post exposure. The results of behavioral tests indicate that exposure

to high concentrations (4.7 mg/1) of APCO-467 for 1 hour or lower concentrations (1.3 mg/1) for 4 hours impaired rat avoidance performance for almost 24 hours. Pulmonary function tests indicate possible transitory lung irritation in rabbits exposed to Pyrocide-175, APCO-467 and MGK-264. Data indicate that the compound is nonmutagenic. It is recommended that approval be granted for the use of Pyrethrins Fogging Concentrate to be used in conjunction with the hand-held ULV insecticide dispersal machine following manufacturer's labeling instructions. GRA

**N78-31716#** Franklin Inst. Research Labs., Philadelphia, Pa. Science Information Services Dept.

**A LITERATURE REVIEW: PROBLEM DEFINITION STUDIES ON SELECTED TOXIC CHEMICALS. VOLUME 6: OCCUPATIONAL HEALTH AND SAFETY AND ENVIRONMENTAL ASPECTS OF UREA-FORMALDEHYDE RESINS Final Report, Mar. 1977 - Apr. 1978**

Shu-hsi Hsiao and John E. Villaume Apr. 1978 65 p refs
(Contract DAMD17-77-C-7020; DA Proj. 3E7-62720-A-835)
(AD-A054991) Avail: NTIS HC A04/MF A01 CSCL 06/1

The Problem Definition Study provides a literature review (88 references) on occupational health hazards and environmental impacts on urea-formaldehyde resins. This study covers the physical and chemical properties, toxicity in humans and animals, effects on microorganisms, plants, and soil organisms, pharmacokinetics, fate in the environment, industrial safety standards and practices and sampling and analysis of urea-formaldehyde resins. Environmental impacts are discussed and recommendations for further studies are provided. Urea-formaldehyde resins are mixtures of condensation products of urea and formaldehyde with indefinite composition, and structure depending on the degree of polymerization. The highly polymerized resins are inert solids which are very stable under ambient conditions and are not readily degraded in the environment. The low molecular weight condensation products are viscous liquids or powdery solids which decompose easily, releasing free formaldehyde that is highly irritating to eyes, skin and mucous membranes of humans and animals. They can be used as antibacterial products. GRA

**N78-31717#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**CONTRAST SENSITIVITY OF THE HUMAN VISUAL SYSTEM AT ONE LUMINANCE LEVEL WHILE ADAPTED TO A STIMULUS AT ANOTHER LUMINANCE LEVEL M.S. Thesis**

Carl P. Scheidegg Dec. 1977 191 p refs
(AD-A055238; AFIT/GE/EE/77D-34) Avail: NTIS HC A09/MF A01 CSCL 06/16

This report documents an investigation of the hypothesis that receptive field organization in the human visual system changes due to a change in stimulus average luminance. Adaptation and testing at the same average luminance produced a depression in the contrast sensitivity curve centered over the adapting spatial frequency. A difference in average luminance between the adapting pattern and the test pattern was expected to produce a spatial frequency shift in the depression of the adaptation curve. Some shift in the adaptation depression was observed indicating that some kind of change in the visual system had occurred, however, the results did not provide sufficient evidence to conclude that a receptive field size change had taken place as a result of the luminance change. GRA

**N78-31718#** Oregon Univ. Health Sciences Center, Portland. Biophysics Lab.

**ELECTRICAL ENHANCEMENT OF HEALING IN COMBAT INJURIES TO HARD AND SOFT TISSUES Annual Summary Report**

B. S. Savara, R. W. Fields, R. B. Tacke, and M. H. Bartley 20 May 1978 43 p refs
(Contract DADA17-72-C-2185; DA Proj. 3S7-62775-A-825)
(AD-A055531) Avail: NTIS HC A03/MF A01 CSCL 06/5

Over the past decade a large body of experimental evidence has accumulated showing the positive influence of electric currents on bone metabolism. It is evident that modeling, remodeling and repair are regulated, through bone's piezoelectric properties as mechanical transducers in a closed loop system. In situations where enhancement of normal function of the transducer system is desirable, viz during bone repair, it would be advantageous to use an exogenous source of electric current. Author (GRA)

**N78-31719#** Technology, Inc., San Antonio, Tex. Life Sciences Div.

**AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF 1.06 MICROMETERS LASER LIGHT ON THE TRANSPARENT OCULAR MEDIA Final Report, 1975 - 1977**

Norma D. Miller Jun. 1977 16 p refs
(Contract DAMD17-75-C-5040; DA Proj. 3A7-62758-A-824; DA Proj. 3E7-62772-A-813)
(AD-A055650) Avail: NTIS HC A02/MF A01 CSCL 06/16

A unique camera attachment for a Zeiss Slit Lamp is described. The purpose of the camera is to provide a means of quantifying changes in the scattering properties of the lens. The film plane is tilted at an angle to the axis of the biomicroscope to permit sharp imagery of the entire illuminated cross section of the cornea and lens. A photographic step wedge is included in the film plane and is illuminated by a sample of the slit beam after passing through the microscope and camera optics. Typical photographs are presented. Author (GRA)

**N78-31720#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

**DESCRIPTION AND ANALYSIS OF THE HEWLETT-PACKARD 78220 ARRHYTHMIA MONITORING SYSTEM M.S. Thesis**

Samuel L. Harris Mar. 1978 61 p refs
(AD-A055451; AFIT/GE/EE/78-2) Avail: NTIS HC A04/MF A01 CSCL 06/2

The Hewlett-Packard (HP) 78220 Arrhythmia Monitoring System is ventricular-oriented and detects the most significant ventricular contractions (PVCs) of Lead II electrocardiograms (ECGs). The HP monitoring software consists of a number of relocatable program modules. The program modules are divided into three main categories. The first is called system initialization, the second is real time processing, and the third is background processing. The real time portion includes the AZTEC transformation which is applied to the input waveform and records only the changes in the waveform that succeed some predetermined threshold to achieve a tremendous data reduction. GRA

**N78-31721#** California Univ., Livermore. Lawrence Livermore Lab.

**DESIGN AND CONSTRUCTION OF THE DONNER 280-CRYSTAL POSITRON RING FOR DYNAMIC TRANSVERSE SECTION EMISSION IMAGING**

Stephen E. Derenzo, Paul G. Banchero, John L. Cahoon, Ronald H. Huesman, Tony Vuletich, and Thomas F. Budinger Sep. 1977 11 p refs Presented at IEEE Conf. on Decision and Control, New Orleans, 7 Dec. 1977
(Contract W-7405-eng-48)
(LBL-5679; Conf-771205-1) Avail: NTIS HC A02/MF A01

The design and construction of a medical imaging system for the rapid, accurate, three-dimensional imaging of positron-labeled compounds in the human body are described. The medical research goals included quantifying blood flow and metabolism in human heart muscle and brain. The system consisted of a large gantry containing lead shielding and a ring of 280 NaI(Tl) detectors that completely encircled the patient; 280 photomultiplier tubes, preamplifiers and timing discriminators; circuits that determined whenever a crystal has detected a gamma ray in time coincidence (i.e., within 12 nsec) of any of the opposing 105 crystal and determined the addresses of the crystal involved; 120K words of 12 bit memory for the simultaneous acquisition of data from eight portions of the cardiac cycle; and a hardwired image reconstructor capable of filtering and back-projecting data from 140 views to form a 210 x 210 computed transverse section image in less than 2 sec. ERA

**N78-31722#** Oak Ridge National Lab., Tenn.

**ORIS: THE OAK RIDGE IMAGING SYSTEM PROGRAM LISTINGS**

P. R. Bell and J. M. Dougherty Apr. 1978 417 p
(Contract W-7405-eng-26)
(ORNL-TM-5875-V3) Avail: NTIS HC A18/MF A01

The imaging system is a general purpose access, storage, processing and display system for nuclear medicine imaging with

rectilinear scanner and gamma camera. Listings of the PDP-8/E version of ORIS version '2 are discussed. The system is designed to run under the OS/8 monitor in 16 K or more words of core. System and image file mass storage is on RK8E disk; longer-time image file storage is provided on DECtape. Another version of this program exists for use with the RF08 disk, and a more limited version is for DECtape only. ERA

**N78-31723#** Greenfield, Attaway and Tyler, Inc., San Rafael, Calif.
**NITROGEN OXIDES: CURRENT STATUS OF KNOWLEDGE Final Report**
Anthony V. Colucci and William S. Simmons Feb. 1978 198 p refs
(EPRI Proj. TR-11900-5)
(EPRI-EA-668) Avail: NTIS HC A09/MF A01

The current state of knowledge regarding dioxide, nitrites, nitrates, peroxacyl nitrates, and N-nitrosoamines is reviewed. A critical review is provided of existing toxicological, human clinical and epidemiological assessment methodologies and data. Special consideration is given to the identification and explanation of the controversial issues surrounding health effects which have been related to ambient levels of NO2/NO. Evaluation of existing information on the effects of suspended nitrates and airborne nitrosoamines is emphasized. Suggestions are offered for future research programs involving the health effects of nitrogen oxides. ERA

**N78-31724#** Los Alamos Scientific Lab., N. Mex.
**LATE BIOLOGICAL EFFECTS OF IONIZING RADIATION AS INFLUENCED BY DOSE, DOSE RATE, AGE AT EXPOSURE, AND GENETIC SENSITIVITY TO NEOPLASTIC TRANSFORMATION**
J. F. Spalding, J. R. Prine, and G. L. Tietjen 1978 11 p Presented at Symp. on Late Biol. Effects of Ionizing Radiation, Vienna, 13-17 Mar. 1978; sponsored by IAEA
(Contract W-7405-eng-36)
(LA-UR-78-681; Conf-780306-4; IAEA-SM-224/201) Avail: NTIS HC A02/MF A01

The late biological effects of whole-body exposure to gamma irradiation as they may be influenced by total dose, dose rate, age at exposure, and genetic background were studied. Strain C57B1/6J mice of four age groups (newborn, 2, 6, and 15 months) were given five doses (20, 60, 180, 540, and 1620 rad) of gamma rays, with each dose being delivered at six dose rates (0.7, 2.1, 6.3, 18.9, 56.7 rad/day and 25 rad/min). Groups of forty to sixty mice were used in each of the approximately 110 dose/dose-rate and age combinations. The study was done in two replications with an equal number of mice per replication. Strain RF/J mice were used in a companion study to investigate the influence of genetic background on the type and magnitude of effect. Results of the first and second replications of the 15-month-old age group and data on the influence of genetic background on biological response show no significant life shortening within the dose and dose-rate range used. ERA

**N78-31725#** Brookhaven National Lab., Upton, N. Y. Biomedical and Environmental Assessment Div.
**HAZARDS OF ORGANIC WORKING FLUIDS**
Samuel Silberstein Aug. 1977 21 p refs
(Contract EY-76-C-02-0016)
(BNL-50761) Avail: NTIS HC A02/MF A01

Several brief reviews on working fluids proposed for use in organic Rankine and bi-phase bottoming cycles are presented. There are several general problems with many organic working fluids; flammability, toxicity, and a tendency to leak through seals. Two of the proposed working fluids will be used at temperatures above the manufacturer's maximum recommended temperature, and one will be used in a way different from its customary usage. In some cases, it may be more profitable to first seek alternative working fluids before committing large amounts of time and money to research projects on unsafe working fluids. ERA

**N78-31726#** Research Inst. of National Defence, Stockholm (Sweden).
**CORRELATIONS BETWEEN NIGHT VISION TESTS**
Hans Marmolin Dec. 1977 27 p refs Sponsored in part by Delegation for Appl. Med. Defence Res., Found. Fylgias 80-AArs Fond, and Mil. Med. Exam. Centre
(FOA-C-56014-H9) Avail: NTIS HC A03/MF A01

An investigation of interindividual correlations between five night vision tests used in eye clinics is reported. Correlations were computed between the twenty measures of night vision ability obtained from the five tests and a principal component analysis was performed of the correlation matrixes. Six independent factors were obtained: a contrast sensitivity factor; a light sensitivity factor; two glare sensitivity factors, one related to recovery from a point glare source, one related to recovery from a diffuse glare source; and two adaptation factors, one mesopic and one scotopic. Author (ESA)

**N78-31727#** Auerbach Associates, Inc., Philadelphia, Pa.
**NITROSAMINES Final Report**
Jerome T. Maddock, Wendy L. Byer, Roger T. Malseed, John Keresztesy, and Arthur Katz 17 Dec. 1977 92 p refs
(Contract CPSC-C-76-0067)
(PB-280479/7; AAI-2383/2384-800-TR-2) Avail: NTIS HC A05/MF A01 CSCL 06T

The known existence of nitrosamines in consumer products and to what extent they present a hazard to people was reviewed. Evidence of acute and chronic toxicity, carcinogenicity, mutagenicity and teratogenicity was shown for many animal species but not directly for man. GRA

**N78-31728#** Auerbach Associates, Inc., Philadelphia, Pa.
**STRONG SENSITIZERS Final Monograph**
Jerome T. Maddock, Marcus Sittenfield, and Diane Neff 18 Nov. 1977 203 p refs
(Contract CPSC-C-76-0067)
(PB-280475/5; AAI-2383/2384-300-TR-2) Avail: NTIS HC A10/MF A01 CSCL 06T

Data for the evaluation of potential additions to, and/or modifications of the Federal Hazardous Substances Act Regulations are presented. Strong sensitizers are redefined in terms of severity of the reaction. The practicality and predictive value of patch testing is discussed as is the evolving state of current epidemiological data. It was proposed that a criteria be developed to clearly designate substances as strong sensitizers based upon: (1) frequency of sensitization in normal individuals; (2) frequency in exzema patients; (3) frequency in animal models; (4) frequency in occupationally exposed populations, and/or nature of the reaction, overt vs. covert, transient vs. chronic, and explosive vs. smoldering. GRA

**N78-31729#** General Electric Co., Schenectady, N. Y. Corporate Research and Development.
**DEVELOPMENT AND EVALUATION OF AN ULTRASONIC IMAGING SYSTEM Final Report, 15 Mar. 1976 - 13 Oct. 1977**
Henry A. F. Rocha 14 Oct. 1977 70 p
(Contract N01-HV-5-2966)
(PB-279834/6; SRD-77-185) Avail: NTIS HC A04/MF A01 CSCL 06L

An infrared laser transmitting transducer capable of generating fast acoustic pulses and of an electrostatic receiving transducer with a correspondingly broad bandwidth were developed for acoustic visualization of atheroma in the coronary arteries. The transmitting transducer was operated successfully. One form of the receiving transducer was found to operate with acceptable sensitivity and bandwidth; however, operation of different units was nonreproducible on a regular basis. GRA

**N78-31730#** Health Effects Research Lab., Research Triangle Park, N. C. Criteria and Special Studies Office.
**AIR QUALITY CRITERIA FOR LEAD**
Dec. 1977 299 p refs
(PB-280411/0; EPA-600/8-77-017) Avail: NTIS HC A13/MF A01 CSCL 06T

The relationships between airborne lead and consequent effects on man and his environment are considered. Although this document deals mainly with airborne lead, it also outlines other environmental routes of exposure to lead and gives approximations of the relative contributions to human exposure of the respective routes. In man, lead primarily affects red blood cells, the central and peripheral nervous systems, soft tissues,

such as liver and kidney, and bone; the latter ultimately sequesters 95% of the body's lead burden. Significant biological indices of exposure to lead include microgram quantities of lead and of erythrocyte protoporphyrin (EP) per deciliter of blood (micrograms/d). Adverse effects range from elevated EP and mild anemia at 20 to 40 micrograms/di--through gastrointestinal, renal, and hepatic pahtologies--to severe neurobehavioral impairment. GRA

**N78-31731#** Harvard School of Public Health, Boston, Mass. Dept. of Physiology.

**PHYSIOLOGICAL RESPONSE TO ATMOSPHERIC POLLUTANTS**

Mary O. Amdur Mar. 1978 44 p refs
(Grant EPA-R-802030)
(PB-280413/6; EPA-600/1-78-021) Avail: NTIS HC A03/MF A01 CSCL 06T

Several materials were examined as air pollutants of interest for their irritant effects. These included sulfuric acid, a series of inorganic sulfates, and a combination of ozone and sulfur dioxide. Some attention was also given to the effect of various oil mists on the irritant response to sulfur dioxide. By relating intrapleural pressure change to change in flow rate points of equal lung volume, it was possible to calculate the flow resistance; by relating pressure change to volume at the beginning and end of inspiration, it was possible to calculate compliance. These studies indicate that the irritant response previously observed at higher concentrations of sulfuric acid is also observed at concentrations below 1 mg cu m. GRA

**N78-31732#** National Technical Information Service, Springfield, Va.

**COLD WEATHER STRESS ON HUMANS. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - May 1978**

Elizabeth A. Harrison Jun. 1978 138 p Supersedes NTIS/PS-77-0456;NTIS/PS-76-0347; NTIS/PS-75/170
(NTIS/PS-78/0540/1; NTIS/PS-77/0456; NTIS/PS-76/0347; NTIS/PS-75/170) Avail: NTIS HC $28.00/MF $28.00 CSCL 06S

The selected abstracts cover cold stress, cold tolerance, cold injuries, acclimatization, protective clothing, and cold water exposure as related to cold weather stress on humans. (This updated bibliography contains 132 abstracts, 21 of which are new entries to the previous edition.) GRA

**N78-31733#** Informatics, Inc., Rockville, Md.

**FEDERAL NOISE RESEARCH IN NOISE EFFECTS Final Report**

14 Feb. 1978 164 p
(Contract EPA-68-01-0788)
(PB-280335/1; EPA-550/9-78-102) Avail: NTIS HC A08/MF A01 CSCL 06S

The program was documented and reviewed. The program expanded slightly over the last few years, with more agencies participating. The program is reasonably comprehensive and in general coordinated with no unjustified overlap of efforts. Research needs to support and justify regulatory and standards requirements were identified by the Panel as being of the highest priority. Satisfaction of these relatively short term goals with present budget restrictions could jeopardize long-range basic research needs to understand basic effects mechanisms. To satisfy both requirements, the Panel on the average recommends an increase of the overall Federal noise effects research budget of 40%. The panel recommends several specific research topics for high priority funding. Among the areas requiring additional support are effects of noise on sleep, and community or collective response. GRA

**N78-31696#** Joint Publications Research Service, Arlington, Va.

**ELECTRORECEPTORS IN MAN AND OTHER ANIMALS**

O. B. Ilinskiy *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 35 (JPRS-71467) 14 Jul. 1978 p 56-59 refs Transl. into ENGLISH from Zdorovye (Moscow), no. 4, 1978 p 12-13 (For primary document see N78-31694 22-51)
Copyright. Avail: NTIS HC A06/MF A01

**N78-31698#** Joint Publications Research Service, Arlington, Va.

**GENETICS OF MICROORGANISMS AND MEDICINE**

V. D. Timakov and N. F. Gamaleya *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 25-40 refs Transl. into ENGLISH from Zh. Obshch. Biol. (Moscow), no. 3, 1978 p 335-346 Presented at the All-Union Soc. of Geneticists and Breeders, Leningrad, May 1977 (For primary document see N78-31697 22-51)
Copyright. Avail: NTIS HC A05/MF A01

**N78-31699#** Joint Publications Research Service, Arlington, Va.

**SOME PRESSING PROBLEMS OF GENETICS**

N. P. Dubinin *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 41-52 refs Transl. into ENGLISH from Zh. Obshch. Biol. (Moscow), no. 3, 1978 p 347-356 Presented at the 3d Congr. of the All-Union Soc. of Geneticists and Breeders, Leningrad, May 1977 (For primary document see N78-31697 22-51)
Copyright. Avail: NTIS HC A05/MF A01

**N78-31702#** Joint Publications Research Service, Arlington, Va.

**A VARIANT OF PORTABLE SINGLE-CHANNEL BIORADIOTELEMETRY SYSTEM**

A. A. Shaptala, V. S. Sautkin, and V. V. Zabrodin *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 64-66 ref Transl. into ENGLISH from Gig. Tr. (Moscow), no. 6, 1978 p 56-58 (For primary document see N78-31697 22-51)
Copyright. Avail: NTIS HC A05/MF A01

**N78-31704#** Joint Publications Research Service, Arlington, Va.

**DEPENDENCE OF THE REACTION OF THE HUMAN NERVOUS SYSTEM ON THE DISTRIBUTION OF ABSORBED DOSES OF IONIZING RADIATION**

G. I. Kirsanova *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 P 76-84 refs Transl. into ENGLISH from Med. Radiol. (Moscow), no. 5, 1978 p 3-8 (For primary document see N78-31697 22-51)
Copyright. Avail: NTIS HC A05/MF A01

**N78-31706#** Joint Publications Research Service, Arlington, Va.

**COAGULATIVE PROPERTIES OF BLOOD AND TISSUES OF THE CARDIOVASCULAR SYSTEM IN EXPOSURE TO ELECTROMAGNETIC FIELDS**

V. Ye. Kuksinskiy *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 40 (JPRS-71595) 1 Aug. 1978 p 1-7 refs Transl. into ENGLISH from Kardiologiya (Moscow), no. 3, 1978 p 107-110 (For primary document see N78-31705 22-51)
Copyright. Avail: NTIS HC A04/MF A01

**N78-31707#** Joint Publications Research Service, Arlington, Va.

**PROLIFERATION OF BONE MARROW CELLS UNDER THE INFLUENCE OF SUPERHIGH INTENSITY STEADY MAGNETIC FIELDS**

A. D. Strzhizhovskiy and G. V. Galaktionova *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 40 (JPRS-71595) 1 Aug. 1978 p 8-12 refs Transl. into ENGLISH from Tsitologiya (Leningrad), no. 6, 1978 p 717-720 (For primary document see N78-31705 22-51)
Copyright. Avail: NTIS HC A04/MF A01

## 53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**N78-31734#** Seville Research Corp., Pensacola, Fla.
**US NAVY FLEET AVIATION TRAINING PROGRAM DEVELOPMENT Final Report, Oct. 1976 - Oct. 1977**
Wallace M. Prophet Mar. 1978 90 p refs Prepared in Cooperation with Human Resources Research Organization, Alexandria, Va.
(Contract N61339-77-C-0009)
(AD-A055788; HUMRRO-FR-ED-77-25) Avail: NTIS HC A05/MF A01 CSCL 05/9

Four specific aircraft training program development efforts (A-6E, E-2C, EA-6B, and SH-2F) were examined and compared as to methodology and procedures used. The four efforts embodied principles of the Systems Approach to Training (SAT) and/or Instructional Systems Development (ISD). Three different contractors were involved, and the programs were under the technical direction of the Naval Training Equipment Center. The four projects carried through the point in the SAT/ISD process of development of lesson specification documents. In addition to examining procedural and methodological differences of the four programs, the report describes the various program products and examines their utility for subsequent steps in the SAT/ISD process. The report also examines the general model that has been evolving in a variety of NAVTRAEQUIPCEN sponsored efforts for the conduct of SAT/ISD programs. The model and its associated documentation are examined in terms of their utility for aviation training program developmental efforts. The report concludes that these various activities have advanced the Navy:s capabilities significantly for the development of more effective aviation training program efforts in the future. Several areas are suggested for further improvement of the model. These include: (1) making it more applicable to complex in-cockpit psycho-motor skills (as contrasted with cognitive skills); (2) techniques of flight performance measurement, and (3) means of enhancing the role of simulator training in the model. GRA

## 54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

**N78-31735*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**SPACESUIT MOBILITY JOINTS Patent**
Hubert C. Vykukal, inventor (to NASA) Issued 30 May 1978 22 p Filed 23 Dec. 1976 Supersedes N77-15641 (15 - 06 p 0789)
(NASA-Case-ARC-11058-1; US-Patent-4,091,464; US-Patent-Appl-SN-753965; US-Patent-Class-2-2.1A; US-Patent-Class-285-235) Avail: US Patent Office CSCL 05H

Joints for use in interconnecting adjacent segments of an hermetically sealed spacesuit which have low torques, low leakage and a high degree of reliability are described. Each of the joints is a special purpose joint characterized by substantially constant volume and low torque characteristics. Linkages which restrain the joint from longitudinal distension and a flexible, substantially impermeable diaphragm of tubular configuration spanning the distance between pivotally supported annuli are featured. The diaphragms of selected joints include rolling convolutions for balancing the joints, while various joints include wedge-shaped sections which enhance the range of motion for the joints.
Official Gazette of the U.S. Patent Office

**N78-31736*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**SPACESUIT TORSO CLOSURE Patent**
Bruce W. Webbon and Hubert C. Vykukal, inventors (to NASA) Issued 30 May 1978 8 p Filed 23 Mar. 1977 Supersedes N77-25784 (15 - 16, p 2170)
(NASA-Case-ARC-11100-1; US-Patent-4,091,465; US-Patent-Appl-SN-780569; US-Patent-Class-2-2.1A) Avail: US Patent Office CSCL 05H

A simple, economical and reliable entry closure is described for joining opposite halves of a torso section for a pressure suit in a manner which simplifies self-donning. A single coupling joins coaxially aligned, axially separable, tubular segments of a hard spacesuit along an angulated zone of separation, adapted to be mated in an hermetrically sealing relation. A releasable C section clamp secures the members in their mated relationship.
Official Gazette of the U.S. Patent Office

**N78-31737** Stanford Univ., Calif.
**A COMPARISON OF CONTROL MODES FOR TIME DELAYED REMOTE MANIPULATION Ph.D. Thesis**
Gregory Paul Starr 1978 220 p
Avail: Univ. Microfilms Order No. 78-14212

The hypothesis that a joystick-rate-control system, where removal of the operator's hand from the joystick insures zero velocity, will degrade less with time delay than a master-slave control system was tested. Master-slave control and rate-control were implemented on the NASA Ames remote manipulator. This manipulator's unusual geometry required the use of Resolved Motion Rate-Control which uses a digital computer to assist the operator. A peg-in-hole transfer task was used in the manipulation experiments, and data acquisition was done by digital computer, providing an extremely accurate record of performance. Manipulator hand position as well as completion times were recorded. Results indicate that the rate control system was more effective in those portions of the task requiring high accuracy. Master-slave control appears superior in portions of the task emphasizing speed.
Dissert. Abstr.

**N78-31738#** Royal Aircraft Establishment, Farnborough (England).
**THE VIBRATING ENVIRONMENT IN TRANSPORT VEHICLES: A CRITICAL BIBLIOGRAPHICAL STUDY**
G. Bonnardel, B. Favre, and J. L. Flores Mar. 1978 152 p refs Transl. into ENGLISH of "Environement Vibratoire dans les Vehicules de Transport., Etude Bibliographique Critique", Rept. IRT-12 Inst. de Rech. des Transports, France, Dec. 1975 152 p.
(RAE-Lib-Trans-1917; BR64081) Avail: NTIS HC A08/MF A01

A physical description of the vibratory and dynamic environment of a road vehicle is given in order to understand the vibratory stimuli to which a passenger is subjected. Special attention was paid to the vehicle suspension and to the seats. The passenger was considered as a mechanical model for exploring human body behavior under the effect of vibratory stimuli. The physiological reactions of a person subjected to such a loading were used to establish criteria of human tolerance to vibrations. In particular, the case of the ISO standard TC-108 is examined. Emphasis is placed on human tolerance to acceleration and jerk.
G.G.

**N78-31739*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**A PILOT EVALUATION OF TWO G-SEAT CUEING SCHEMES**
Thomas W. Showalter Aug. 1978 34 p refs
(NASA-TP-1255; A-7390) Avail: NTIS HC A03/MF A01 CSCL 05H

A comparison was made of two contrasting G-seat cueing schemes. The G-seat, an aircraft simulation subsystem, creates aircraft acceleration cues via seat contour changes. Of the two cueing schemes tested, one was designed to create skin pressure cues and the other was designed to create body position cues. Each cueing scheme was tested and evaluated subjectively by five pilots regarding its ability to cue the appropriate accelerations in each of four simple maneuvers: a pullout, a pushover, an S-turn maneuver, and a thrusting maneuver. A divergence of pilot opinion occurred, revealing that the perception and acceptance of G-seat stimuli is a highly individualistic phenomena. The creation of one acceptable G-seat cueing scheme was, therefore, deemed to be quite difficult.
L.S.

**N78-31740*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**DISPOSAL OF RADIOACTIVE IODINE IN SPACE**
Rowland E. Burns and J. Gregory Defield Aug. 1978 40 p refs

(NASA-TP-1313; M-260) Avail: NTIS HC A03/MF A01 CSCL 06T

The possibility of space disposal of iodine waste from nuclear power reactors is investigated. The space transportation system utilized relies upon the space shuttle, a liquid hydrogen/liquid oxygen orbit transfer vehicle, and a solid propellant final stage. The iodine is assumed to be in the form of either an iodide or an iodate, and calculations assume that the final destination is either solar orbit or solar system escape. It is concluded that space disposal of iodine is feasible. Author

**N78-31741#** Naval Weapons Center, China Lake, Calif.
**DISPLAY SIZE AND TARGET ACQUISITION PERFORMANCE Report, Jul. 1976 - Oct. 1977**
Michael J. Barnes Jan. 1978 47 p refs
(WF55525000)
(AD-A054624; NWC-TP-6006) Avail: NTIS HC A03/MF A01 CSCL 05/8

Two experiments were conducted to find factors that have an important effect on display size criteria in a cockpit-display system. Subjects in both experiments detected military targets simulating images from a TV camera looking obliquely forward as it is flown over the terrain. The results of the two experiments indicated that the physical size of a television monitor is not an important factor if MTF and visual angle are held constant. Of the factors studied, the four most important were: number of targets, visual angle of targets, target contrast, and target configuration. The data from the second experiment were used to generate a multiple regression model. The relationship between target visual angle and display size allowed the regression model to be used to predict performance as a function of display size. Author (GRA)

**N78-31742#** Army Aeromedical Research Lab., Fort Rucker, Ala.
**VISUAL WORKLOAD OF THE COPILOT/NAVIGATOR DURING TERRAIN FLIGHT Final Report**
Michael G. Sanders, Ronald R. Simmons, and Mark A. Hofmann Dec. 1977 33 p refs
(AD-A055038; USAARL-78-5) Avail: NTIS HC A03/MF A01 CSCL 05/9

The emphasis on aviator workload has been of primary concern to the U.S. Army aviation community since the incorporation of low altitude terrain flight techniques into the helicopter tactics repertory. Since navigation is a particularly acute problem at low altitudes, this project examined the visual workload of the navigator/copilot during terrain flight (nap-of-the-earth, contour and low level) in a UH-1H helicopter. The navigator's task was to: (1) perform a map study of the prescribed course, (2) direct the pilot during the flight as to the direction of flight, altitude and airspeed desired to traverse the course, and (3) identify hover points and checkpoints along the route which were given to the navigator in terms of six digit grid coordinates. Visual performance was measured via a modified NAC Eye Mark Recorder used in conjunction with a LOCAM high speed camera. This technique provided the means to objectively record and analyze the navigator's visual performance through the examination of: (1) visual time inside the cockpit on flight and engine instruments, (2) time inside the cockpit on the map or other navigation aids, and (3) time outside the cockpit in various windscreen sectors. GRA

**N78-31743#** Texas Univ. at Arlington. Dept. of Mechanical Engineering.
**AN EVALUATION OF THE FLUIDIC OXYGEN PARTIAL PRESSURE SENSOR Final Report, Jan. - Jul. 1976**
Robert L. Woods Dec. 1977 76 p refs
(Contract F41609-76-C-0028)
(AD-A055362; FLCS-7601; SAM-TR-77-31) Avail: NTIS HC A05/MF A01 CSCL 06/11

A theoretical concept for a fluidic gas partial pressure sensor is evaluated. In the sensor concept, a fluidic resistive bridge gas concentration sensor is powered by the vacuum produced with a compressible flow ejector. Because of the ejector characteristics, the pressure drop across the bridge is proportional to the ambient pressure; hence, the sensor output is proportional to the gas concentration and the ambient pressure, the product of which is partial pressure. A complete mathematical model is derived that is in close agreement with the experiment. A prototype sensor is discussed and tested over a range of 0.3 to 1.0 atmospheres pressure and 0 to 100% concentrations of CO2 in air and O2 in air. The test results show that the sensor responds to both variables. Environmental sensitivities and signal amplification are discussed. Author (GRA)

**N78-31744#** Mitre Corp., McLean, Va. METREX Div.
**VIBRATION ASPECTS OF RIDE QUALITY MODELING FOR THE DOT PTACV: THEORY AND EXPERIMENT**
Roger Katz Dec. 1977 59 p refs
(Contract DOT-FR-54090)
(PB-279846/0; MTR-7692; FRA/ORD-78/02) Avail: NTIS HC A04/MF A01 CSCL 13F

Analytical models to predict the acceleration levels at frequencies which affect passenger ride confort have been developed. The suitability of analytical models used to predict the heave acceleration in the passenger cabin of The Department of Transportation's Prototype Tracked Air Cushion Vehicle (PTACV) is discussed. A comparison of theoretical predictions from an analytical model, typical of those in common usage, with measured response accumulated during testing of the PTACV on its test track is presented. GRA

**N78-31745#** Advisory Group for Aerospace Research and Development, Paris (France).
**METHODS TO ASSESS WORK LOAD**
Jun. 1978 136 p refs Presented at the Aerospace Med. Panel Specialists Meeting, Cologne, 18-22 Apr. 1977
(AGARD-CP-216; ISBN-92-835-1285-5) Avail: NTIS HC A07/MF A01

Physiological and mathematical methods are examined for determining pilot and air traffic controller workloads. For individual titles, see N78-31746 through N78-31758.

**N78-31746#** Naval Aerospace Medical Research Lab., Pensacola, Fla.
**IS MAN THE WEAKEST LINK?**
Harvey G. Gregoire *In* AGARD Methods to Assess Workloads Jun. 1978 3 p (For primary document see N78-31745 22-54)
Avail: NTIS HC A07/MF A01

A portable video tape recorder and camera were installed on the aft bulkhead of the crew compartment to obtain inflight video records of aircrew activity during test flights of a new antisubmarine (ASW) aircraft. The technique proved successful in providing graphic records of real time crew utilization of systems controls and displays. In combination with crew briefing and debriefing interviews, the annotated tapes provided a basis for activity sampling, scoring task times and error rates, evaluating display utilization, counting control inputs and display mode changes, and for other observations pertinent to crew task loading. Data was obtained during passive acoustic submarine search and track operation during actual ASW test flights. This data indicated that during passive acoustic search and tracking, individual control tasks requiring one or more pushbutton operations were performed from 6 to 10 times per minute. Display mode changes occurred at intervals of approximately two minutes. The operators in this limited sample made integrated control system inputs exclusively with the right hand. G.G.

**N78-31747#** Army Aeromedical Research Lab., Fort Rucker, Ala. Aviation Psychology Div.
**METHODOLOGICAL CONSIDERATIONS OF VISUAL WORKLOADS OF HELICOPTER PILOTS**
Ronald R. Simmons and Kent A. Kimball *In* AGARD Methods to Assess Workloads Jun. 1978 9 p refs (For primary document see N78-31745 22-54)
Avail: NTIS HC A07/MF A01

The techniques and modifications for assessing visual performance/workload of pilots during helicopter operations are reviewed. Although the corneal reflection technique for gathering eye movement data is not new, innovative modifications had to be developed to permit accurate data collection in this flight environment. G.G.

**N78-31748#** Human Engineering Labs., Aberdeen Proving Ground, Md.
**USE OF EYE-MOVEMENT MEASURES TO ESTABLISH**

**DESIGN PARAMETERS FOR HELICOPTER INSTRUMENT PANELS**

John A. Barnes *In* AGARD Methods to Assess Workloads Jun. 1978 9 p refs (For primary document see N78-31745 22-54)

Avail: NTIS HC A07/MF A01

The pilot's eye-scan path and fixation point recordings during actual helicopter flight provided an accurate measure of the visual workload imposed by a particular panel design. Initial work was done in the UH-1 helicopter using experienced instrument-rated pilots flying actual maneuvers on instruments. The knowledge gained from these data was used to design a helicopter instrument panel in which the most referred to instruments were placed so that the eye-scan paths were minimized. This design considerably lessens the pilot's visual workload, cuts fatigue and allows him more time for other tasks. G.G.

**N78-31749#** Royal Air Force Inst. of Aviation Medicine, Farnborough (England).

**AUDITORY COMMUNICATION AND WORKLOAD**

Roger Green and Ray Flux *In* AGARD Methods to Assess Workloads Jun. 1978 8 p refs (For primary document see N78-31745 22-54)

Avail: NTIS HC A07/MF A01

Psychomotor workload interference with the performance of an auditory communications task was studied. Two experiments are described: The first illustrates that an auditory task from which a cumulative response time measure is taken is effected by changes in signal quality, and the second experiment shows that the same auditory task is also affected by a realistic form of workload (flying an aircraft simulator). The implications of those findings are discussed both in terms of assessing the quality required of a communications system and in terms of the use of secondary tasks in the assessment of workload. G.G

**N78-31750#** Royal Air Force Inst. of Aviation Medicine, Farnborough (England).

**PITCH AND FORMANT ANALYSIS OF THE VOICE IN THE INVESTIGATION OF PILOT WORKSHOP**

R. Cannings, R. G. Borland, L. E. Hill, and A. N. Nicholson *In* AGARD Methods to Assess Workloads Jun. 1978 11 p refs (For primary document see N78-31745 22-54)

Avail: NTIS HC A07/MF A01

Typical log spectral, cepstral and smoothed spectral estimates, obtained from in-flight recordings, are reported. The pitch peak in the cepstrum corresponded to a constant frequency of 94 Hz. The first formant peak was clearly visible and the peak picking algorithm showed it to be increasing from 520 to 575 Hz through the time course of the phonem. In this particular example the second formant peak is well defined (1400 Hz) and the third and fourth formants may also be seen at 2250 Hz and 3100 Hz, respectively. Preliminary examination of in-flight recordings indicates that this technique is useful for classifying specific phonems and is effective despite the noise corruption of the raw data. The nature of cockpit communications determines the choice of phonems. G.G.

**N78-31751#** Technische Hochschule, Darmstadt (West Germany).

**DETERMINATION OF STRESS AND STRAIN OF AIR TRAFFIC CONTROL OFFICERS**

Walter Rohmert *In* AGARD Methods to Assess Workloads Jun. 1978 8 p refs (For primary document see N78-31745 22-54)

Avail: NTIS HC A07/MF A01

Air traffic controlling means a work system with manual performance. All three partial functions, efficiency/controlling/monitoring, necessary to be fulfilled in each work system are operated by man himself. Based on the concept of the man-at-work-system and the description of strain-related work contents, a new ergonomic job description questionaire was developed. The results allow a deeper inlook into methods and techniques needed for evaluation purposes as well as for designing future air traffic control systems. G.G.

**N78-31752#** Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).

**INSTRUMENTS AND METHODOLOGY FOR THE ASSESSMENT OF PHYSIOLOGICAL COST OF PERFORMANCE OF STRESSFUL CONTINUOUS OPERATIONS: THE AIR TRAFFIC SERVICES TOWER ENVIRONMENT**

Jacques Soutendam *In* AGARD Methods to Assess Workloads Jun. 1978 32 p refs (For primary document see N78-31745 22-54)

Avail: NTIS HC A07/MF A01

A total of 39 females and males were used as subjects in a study designed to test the general validity and utility of methods and instruments of potential use in the determination of the physiological cost of work performance in stressful environments. A second goal of the study was to attempt a preliminary test of the hypothesis that a form of employment (air traffic service) traditionally considered stressful, was significantly different from general forms of employment traditionally considered less stressful. A consistent statistical significance was established when the entire sample was recategorized on the basis of subjective sleep adequacy assessment rather than by job description. G.G.

**N78-31753#** Technische Universitaet, Munich (West Germany). Inst. fuer Arbeitsphysiologie.

**PHYSIOLOGICAL MEASURES OF WORKLOADS: CORRELATIONS BETWEEN PHYSIOLOGICAL PARAMETERS AND OPERATIONAL PERFORMANCE**

Helmut Strasser *In* AGARD Methods to Assess Workloads Jun. 1978 8 p refs (For primary document see N78-31745 22-54)

Avail: NTIS HC A07/MF A01

The influence of different hypoxic gas mixtures on pursuit tracking and on some physiological parameters was studied. The following conclusions are made: Already, in relatively mild hypoxia, physiological changes are present, but normally were concealed by reactions due to prolonged test time. In spite of statistically significant physiological effects, no noticeable deterioration of performance in tracking was measured in hypoxia down to a hypoxic gas mixture of only 13% 02 in inspired air. Not until before 11% 02 significant and mentionable impairments of tracking performance were found. The same, shown for hypoxia, is true of noise. Decreased performance in noise was not found, but an increased level of heart rate indicated the stress. Physiological indicators definitely react already in a low workload in order to bring in action reserves of energy. Operational measures alone fail to indicate the strain of the human operator. Only in high workload, correlations performance and physiological measures are expected. G.G.

**N78-31754#** Army Aeromedical Research Lab., Fort Rucker, Ala.

**USE OF INSPIRATORY MINUTE VOLUMES IN EVALUATION OF ROTARY AND FIXED WING PILOT WORKLOAD**

Frank S. Pettyjohn, Roderick J. McNeil, Lloyd A. Akers, and James M. Faber *In* AGARD Methods to Assess Workloads Jun. 1978 3 p refs (For primary document see N78-31745 22-54)

Avail: NTIS HC A07/MF A01

Inspiratory minute volume (IMV) measurements were utilized in the evaluation of US Army aircrew workload and stress in helicopter and fixed wing aircraft. The IMV data demonstrated a significant stress and/or workload level of the aviator in performance of helicopter day nap-of-the-earth NOE), night nap-of-the-earth flight (NNOE) and with the use of night vision devices (NVD). IMV 20.05 to 38.11 liters per minute NTPD were obtained during the performance of these combat operational techniques. IMV determination in-flight is considered a valuable clinical tool in the assessment of aircrew stress and/or workload. G.G.

**N78-31755#** Johann-Wolfgang-Goethe-Universitat, Frankfurt am Main (West Germany).

**NEUROPHYSIOLOGICAL ASSESSMENT OF FUNCTIONAL STATES OF THE BRAIN**

Kurt Offenloch *In* AGARD Methods to Assess Workloads Jun. 1978 4 p refs (For primary document see N78-31745 22-54)

Avail: NTIS HC A07/MF A01

Neurophysiological methods are used to assess functional states of the brain with precision that surpasses that of

classical psychological methods. Not only neurological syndromes, but also slight changes on the vigilance scale as well as functional changes associated with cognitive and intellectual functions can be correlated with the electrical activity of the brain and hereby be objectively determined. G.G.

**N78-31756#** Naval Air Development Center, Warminster, Pa.
**THE HUMAN OPERATOR SIMULATOR: WORKLOAD ESTIMATION USING A SIMULATED SECONDARY TASK**
Norman E. Lane, Melvin I. Strieb (Analytics, Inc., Willow Grove, Pa.), and Robert J. Wherry, Jr. (Analytics, Inc., Willow Grove, Pa.) *In* AGARD Methods to Assess Workloads Jun. 1978 12 p refs (For primary document see N78-31745 22-54)
Avail: NTIS HC A07/MF A01

The use of the human operator simulator (HOS) for identifying potential workload problems is described. HOS is applicable during the midrange of system development, between early analytical prediction methods and later simulator evaluations. The HOS creates a software simulation of a trained human operator, his system hardware/software, and required interforces. The results demonstrate the applicability of HOS for workload evaluation and explore HOS operator behavior under varying conditions of task demand. Problems of definition and methodology for current workload measures are discussed and alternatives identified using HOS to control task difficulty and task demand parameters. The implications of HOS application for cost and flexibility improvements are examined, and further developments of the model for workload evaluation are prepared. G.G.

**N78-31757#** Naval Air Development Center, Warminster, Pa. Dept. of Crew Systems.
**OPERATOR WORKLOAD ASSESSMENT MODEL: AN EVALUATION OF A VF/VA-V/STOL SYSTEM**
Paul M. Linton, Dieter W. Jahns (Boeing Co., Seattle, Wash.), and Paul R. Chatelier (NASC, Washington, D. C.) *In* AGARD Methods to Assess Workloads Jun. 1978 12 p refs (For primary document see N78-31745 22-54)
Avail: NTIS HC A07/MF A01

The term operator workload generally refers to a concept used in evaluating the extent to which a human operator is occupied with meeting system demands. By systematically describing the steps undertaken to estimate the workload in a conceptual fighter/attack V/STOL aircraft, mesting Navy mission requirements, it is shown that while a single crewmember can probably manage the V/STOL in its primary mission phases, additional and refined workload assessment evaluations are required to conclusively settle the issue for all aspects of deployment. G.G.

**N78-31758#** School of Aerospace Medicine, Brooks AFB, Tex.
**MATHEMATICAL ANALYSIS AND COMPUTER SIMULATION IN MILITARY MISSION WORKLOAD ASSESSMENT**
Richard A. Albanese *In* AGARD Methods to Assess Workloads Jun. 1978 7 p refs (For primary document see N78-31745 22-54)
Avail: NTIS HC A07/MF A01

Mathematical and computer approaches to the assessment of crew workload during military missions are discussed. Three analysis tools are reported: (1)estimation algorithms; (2) linear models; and (3) nonlinear/hybrid models. These separate but interacting methods provide increasing levels of detail with the focus on methods which attempt to determine whether a typical aircrew can accomplish the workload presented to it by an aircraft weapon system and mission requirements. G.G.

**N78-31695#** Joint Publications Research Service, Arlington, Va.
**EVOLUTION OF THE SPACE SUIT**
V. B. Malkin and I. N. Chernyakov *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 35 (JPRS-71467) 14 Jul. 1978 p 1-7 Transl. into ENGLISH from Zdorovye (Moscow), no. 4, 1978 p 7-8 (For primary document see N78-31694 22-51)
Copyright. Avail: NTIS HC A06/MF A01

**N78-31703#** Joint Publications Research Service, Arlington, Va.
**A METHOD OF RECORDING HEAT PARAMETERS OF DIVERS DURING WORK**
A. V. Sterlikov *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 39 (JPRS-71569) 28 Jul. 1978 p 67-69 Transl. into ENGLISH from Gig. Tr. (Moscow), no. 6, 1978 p 55-56 (For primary document see N78-31697 22-51)
Copyright. Avail: NTIS HC A05/MF A01

# 55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

# 59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

# 60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering.*

**N78-31759** California Univ., Irvine.
**DECOMPILATION Ph.D. Thesis**
Gregory Littell Hopwood 1978 360 p
Avail: Univ. Microfilms Order No. 7811860

General decompiler design considerations and the design of the particular experimental decompiler are presented. The implementation of the decompiler (using LISP on a DECsystem-10 computer) is described and illustrated by example. The source programs are minicomputer (Varian Data Machines 620/i) assembler language routines, and the target language is a higher level machine oriented language for the same minicomputer. The results of decompiling two larger programs totalling five thousand lines of assembler language text are presented. The performance of the decompiler is analyzed and compared with data from other research projects. A summary of the results and possible future directions in the area of decompilation are discussed.
Dissert. Abstr.

**N78-31760** Oregon State Univ., Corvallis.
**A NEW LOOP STRUCTURE FOR DISTRIBUTED MICRO-COMPUTING SYSTEMS Ph.D. Thesis**
Hossein Jafari 1978 179 p
Avail: Univ. Microfilms Order No. 7811985

A modular loop architecture for distributed computer systems was developed and compared with three of the most prominent loop architectures currently being used. The competitive loops with which the architecture was compared are the Newhal loop, the Pierce loop and the DLCN loop. The four loop architectures were compared by means of simulation models, with the new architecture demonstrating significant improvement in throughput and response time over the competitive systems. The new loop structure introduces two major innovations; use of a separate control loop for control messages flowing between nodes and a loop controller and a partitionable structure for a separate data loop with each segment between two adjacent nodes treated as a separate bus. The simulation results, for the new loop network, were used to guide the development of an M/M/m queueing model. Dissert. Abstr.

**N78-31761** California Univ., Berkeley.
**DESIGN AND IMPLEMENTATION OF AN ADAPTABLE COMPILER FOR MINICOMPUTER TYPE ARCHITECTURE Ph.D. Thesis**
Pariborz Jahanian 1977 181 p
Avail: Univ. Microfilms Order No. 78-12619

Techniques for automatic creation of code generators from a formal specification of minicomputer type architectures are investigated. Specific areas studied include: (1) design of a machine independent, but minicomputer-oriented intermediate language, (2) formalizing the description of the minicomputer programmable resources, (3) automatic translation of the intermediate language instructions into individual minicomputer assembly instructions. These concepts were utilized in a meta compiler for minicomputers, called the Multi Mini Computer Compiler (MMCC). In MMCC, the high-level application language is first translated into the minicomputer-oriented intermediate language, called the Meta Assembly Language (MAL). The MAL is then translated into the symbolic assembly language of the minicomputer whose description is provided as parametric input to MMCC. Dissert. Abstr.

**N78-31762** George Washington Univ., Washington, D. C.
**EXACT FERMAT NUMBER TRANSFORM CONVOLUTION WITH COMPARISON TO FAST FOURIER TRANSFORM TECHNIQUES Ph.D. Thesis**
Lawrence Martin Leibowitz 1978 300 p
Avail: Univ. Microfilms Order No. 7810330

The efficient computation of discrete convolution by Fermat number transform (FNT) methods and comparison with commonly used fast Fourier transform (FFT) techniques are examined. Research is directed towards the realization of finite impulse response (FIR) digital filters, a major application of discrete convolution. A review of number theoretic transform (NTT) theory and the results of previous research is presented. Several multiplication techniques are developed. Algorithms for the direct translation between normal binary and diminished-1 code are developed. Simulation models of real and complex FFT and FNt convolution are developed. Assembly language software implementation of these models, on a CDC 3800, are used to perform a comparative analysis of the two techniques based on a set of comparison criteria. Then number of basic arithmetic operations is determined and utilized to find computation time in terms of total machine cycles required for each procedure. Dissert. Abstr.

**N78-31763*#** M&S Computing, Inc., Huntsville, Ala.
**INTERACTIVE SIGNAL ANALYSIS AND ULTRASONIC DATA COLLECTION SYSTEM USER'S MANUAL Final Report**
G. R. Smith 6 Jun. 1978 40 p
(Contract NAS8-32490)
(NASA-CR-150798; Rept-78-066) Avail: NTIS HC A03/MF A01 CSCL 09B

The operation of a real time data acquisition and display system (ECHO 1) developed for the nondestructive testing laboratory at NASA's Marshall Space Flight Center is described. The system executes on a PDP-11/45 computer with extensive operator interaction providing the requisite parameters to the data collection, calculation, and display modules. Data is obtained in real time from a pulse echo ultrasonic system using a transient recorder. The data consists of 2084 intensity values representing the amplitude of pulses transmitted and received by the ultrasonic unit. Calculations are performed using an MFFT-11 hardware arithmetic processor and fast Fourier transform software. Data display provides near real time plots of all collected and calculated data. A.R.H.

**N78-31764#** Mitre Corp., Bedford, Mass.
**COMPUTER PROGRAM SPECIFICATION FOR SECURITY KERNEL FOR PDP-11/45, VOLUME 1**
S. R. Harper, comp. Apr. 1978 338 p refs
(Contract F19628-75-C-0001)
(AD-A054247; MTR-3178-Vol-1; ESD-TR-76-288-Vol-1) Avail: NTIS HC A15/MF A01 CSCL 09/2

This report presents the Type C5, Computer Program Product Specification for the Security Kernel for the PDP-11/45. It specifies the configuration information that fully describes the Security Kernel as an established program product. A detailed description of each individual function of the program is given. Also included are the requirements which provide the basis for development of verification procedures and a section of informal notes for the potential user. Flow charts are included in an addenda to this report for the convenience of the reader. A complete listing of the Security Kernel program is presented in Section 10, Volume II. Author (GRA)

**N78-31765#** Naval Ship Research and Development Center, Bethesda, Md.
**FEASIBILITY STUDY FOR INCORPORATING A DATA STRUCTURE DEFINITION AND MANIPULATION FACILITY WITHIN THE COMRADE DATA MANAGEMENT SYSTEM Final Report**
Irving S. Zaritsky May 1978 118 p refs
(ZF53532001)
(AD-A055097; DTNSRDC-78/045) Avail: NTIS HC A06/MF A01 CSCL 09/2

A scheme is described for enhancing the COMRADE (Computer-Aided Design Environment) Data Management System. This scheme would produce benefits in data management efficiency, user convenience, power, and cost effectiveness by representing the data structure of a COMRADE data base apart from the data records and by adding a system specifically designed to handle pointer information. In particular, such techniques would: reduce COMRADE use of disk I/O for data block relationships; simplify the organization and administration of the data base; enable the use of a powerful data-definition/data manipulation language; enable the use of an inferential search mechanism; and permit existing programs involving pointer relationships to remain essentially unchanged. The degree of effectiveness achieved under this scheme can be further enhanced by giving the data base administrator a greater role in developing and maintaining the data base in a way to capitalize on the greater flexibility provided. The procedures involved in implementing the proposed scheme and the benefits to be realized from such a scheme are illustrated by describing a hypothetical COMRADE/GIRS system. GIRS (Graph Information Retrieval System) is an in-house developed system written in FORTRAN that is particularly efficient at manipulating pointers. It is easily portable to other machines. GRA

**N78-31766#** Naval Surface Weapons Center, Dahlgren, Va.
**NAVY DISTRIBUTED COMPUTER SYSTEMS WORKSHOP Final Report**
Walter P. Warner and William J. DeJka Apr. 1978 50 p refs
Workshop held at Fredericksburg, Va., 7-9 Jun. 1977
(AD-A055080; NSWC/DL-TR-3790) Avail: NTIS HC A03/MF A01 CSCL 09/2

Results of a workshop held for the purpose of discussing the impact, payoff, and technical issues of distributed computer systems are reported. At the workshop, attendees with diverse backgrounds and experience were able to (1) have a common understanding of distributed systems designs criteria; (2) conduct a quick and complete review of distributed concepts and approaches used in current Navy systems implementation, (3) conduct a state-of-the-art survey of distributed systems theory, (4) compare common issues in relation to Navy-distributed systems, and (5) provide discussions beneficial to both technical and management areas on trends, ideas, and technologies in Navy systems development. Author (GRA)

**N78-31767#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**DESIGN OF A MICROPROCESSOR BASED SYSTEM FOR TESTING OF THE NCR 2051 MNOS MEMORY M.S. Thesis**
Joel W. Robertson 17 Mar. 1978 153 p refs
(AD-A055200; AFIT/GE/EE/78-7) Avail: NTIS HC A08/MF A01 CSCL 14/2

The U.S. Air Force has begun using MNOS memories in ultrahigh frequency radios to provide nonvolatile storage of preset frequencies. The NCR 2051 is one such memory and it is necessary that the USAF have the capability to perform acceptance testing of these devices as well as to economically perform laboratory tests which may be very time consuming. This report develops a microprocessor-based computer system which will provide the

necessary capabilities economically. The design of the Motorola M6800-based system is presented with both hardware and software considerations. The development decisions are discussed and a user's manual is provided. Complete assembly language software listings, which realize the acceptance testing requirements, are included. Flowcharts for all test algorithms and schematic diagrams for all interface circuits are also provided. Author (GRA)

**N78-31768#** Princeton Univ., N. J. Dept. of Electrical Engineering.

**OPTIMUM QUANTIZATION FOR MEMORYLESS DETECTION IN M-DEPENDENT NOISE**

H. V. Poor (Illinois Univ. at Urbana-Champaign) and J. B. Thomas Mar. 1978 9 p refs Presented at the 1978 Johns Hopkins Conf. on Inform. Sci. and Systems, 29-31 Mar. 1978

(Contract DAAB07-72-C-0259; Grant AF-AFOSR-3083-76)

(AD-A055174; AFOSR-78-0919TR) Avail: NTIS HC A02/MF A01 CSCL 17/2

The problem of optimum data quantization for memoryless signal-detection systems operating in m-dependent noise environments is considered. The case where quantizer breakpoints are fixed or predetermined is considered first, and, for this case, existing results for general (unquantized) memoryless detection are modified to yield necessary and sufficient conditions for quantizer optimization in terms of asymptotic efficiency. Necessary conditions are also established for the optimum (asymptotically efficient) selection of quantizer breakpoints, and expressions are presented for the comparison of quantizer-detector performance on the basis of asymptotic relative efficiency. Author (GRA)

**N78-31769#** Arizona Univ., Tucson. Dept. of Chemistry.

**HISS: AN APPROACH TO HIERARCHICAL SYSTEM SHARING FOR LABORATORY COMPUTERS Technical Report, 1 Feb. 1974 - 31 Oct. 1977**

J. B. Phillips, M. F. Burke, and G. S. Wilson Apr. 1978 34 p refs

(Contract N00014-75-C-0512)

(AD-A055152; TR-9) Avail: NTIS HC A03/MF A01 CSCL 09/2

An operating system for a laboratory computer network has been implemented utilizing the principles of hierarchically structured software and hardware. The system was developed using a threaded code technique which is shown to provide a greater degree of expandability and maintainability than is found with operating systems developed with less structured programming techniques. The continuous evolution of computing needs in a research environment requires the availability of user-computer communication at a high level. This operating system provides an environment which facilitates the development of special purpose languages at a very high level by means of the threaded code. The principles of the design of the system are discussed and contrasted with other reported approaches to laboratory computing. Examples which demonstrate the multilevel nature of the design and the advantages of this approach are described. Author (GRA)

**N78-31770#** Indiana Univ. at Bloomington. Dept. of Chemistry.

**COMPUTER IDENTIFICATION OF INFRARED SPECTRA BY CORRELATION-BASED FILE SEARCHING**

Linda A. Powell and G. M. Hieftje 5 May 1978 29 p refs (Contract N00014-77-C-0444)

(AD-A055277; TR-2) Avail: NTIS HC A03/MF A01 CSCL 07/4

A new method for the computerized search and identification of infrared spectra has been developed and evaluated. Based on cross correlation, the search system utilizes all spectral information in a digitized spectrum when it attempts to match an unknown spectrum to one in a small library of known spectra. To evaluate a spectral match, the search program calculates the cross correlation function between the unknown and known (library) spectra which indicates their degree of similarity and allows library spectra to be ranked in order of probability of match to the unknown spectrum. In this study, several small infrared spectral libraries of structurally similar compounds were searched under conditions which examined the sensitivity of the search method to chemical and instrumental variations. Because the correlation technique is slower than conventional file-searching methods, it will probably find greatest use in the search of small collections of similar spectra or as a match-ranking procedure following preliminary selection by a faster search method. Author (GRA)

**N78-31771#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**XEROX CONTROLLER DESIGN M.S. Thesis**

Brian W. Corr Mar. 1978 108 p refs

(AD-A055224; AFIT/GE/EE/78-11) Avail: NTIS HC A06/MF A01 CSCL 09/2

A microprocessor system was designed, based on the Imsai 8048CC Single Board Computer (SBC), to identify authorized volume users of the Xerox copying machine operated by the AFIT Engineering Student Council. A power relay mounted on the SBC was used to enable the Xerox to make copies and a buffer circuit, based on the SN74121 one shot, was employed to count the copies made so that they could be charged to the identified user's account. An interactive FORTRAN program was implemented on the CYBER system available at AFIT to keep a file of authorized users, their unique users numbers, and the identification necessary to bill them. The program in the microprocessor was designed to allow the student council treasurer to set the copy cost, the code used to identify valid user numbers, and any account total (increment, decrement, and set). Routines are also provided to clear all accounts (to zero) and print all non-zero account totals on the TI model 735 terminal. The program is interrupt driven and the account totals, copy cost, and code maintained in memory are protected from loss by a battery backup circuit. GRA

**N78-31772#** National Bureau of Standards, Washington, D. C. Inst. for Computer Sciences and Technology.

**COMPUTER SCIENCE AND TECHNOLOGY: FORTRAN 4 ENHANCED CHARACTER GRAPHICS**

Norman M. Wolcott Apr. 1978 60 p

(PB-279939/3; NBS-SP-500-32) Avail: NTIS HC A04/MF A01 CSCL 09B

A FORTRAN 4 subroutine is described which allows the drawing of six styles of alphabetic characters, three styles of numbers, and 48 special mathematical symbols from the enhanced graphic character set of Dr. A. V. Hershey. Twenty-two symbols for graph plotting are also provided. Output is by linkage to an external subroutine PLOT. The program requires a computer which can accommodate a 30 bit wordlength. GRA

**N78-31773#** National Technical Information Service, Springfield, Va.

**MICROCOMPUTERS: GENERAL APPLICATIONS. CITATIONS FROM THE NTIS DATA BASE Final Report, 1964 - May 1978**

George W. Reimherr Jun. 1978 222 p Supersedes NTIS/PS-77/0325, NTIS/PS-76/0202 and NTIS/PS-75/251

(NTIS/PS-78/0609/4) Avail: NTIS HC $28.00/MF $28.00 CSCL 09B

This bibliography of Federally-funded research cites studies on the applications of minicomputers. These include process control, testing, navigation, instrumentation, biomedicine, machining, training, as well as other applications. GRA

**N78-31774#** National Technical Information Service, Springfield, Va.

**MICROCOMPUTERS. PART 1: GENERAL APPLICATIONS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Final Report, Mar. 1976 - Mar. 1977**

George W. Reimherr Jun. 1978 198 p

(NTIS/PS-78/0611/0) Avail: NTIS HC $28.00/MF $28.00 CSCL 09B

The bibliography of worldwide research literature cites studies on the applications of microcomputers. These include process control, testing, navigation, instrumentation, biomedical, machine tools, and other applications. (This updated bibliography contains 191 abstracts, none of which are new entries to the previous edition.) GRA

**N78-31775#** National Technical Information Service, Springfield, Va.

**MICROCOMPUTERS. VOLUME 4, PART 1: GENERAL APPLICATIONS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Final Report, Apr. 1977 - May 1978**
George W. Reimherr Jun. 1978 377 p Supersedes NTIS/PS-77/0327 and NTIS/PS-76/0204
(NTIS/PS-78/0612/8; NTIS/PS-77/0327; NTIS/PS-76/0204)
Avail: NTIS HC $28.00/MF $28.00 CSCL 09B

The bibliography of worldwide research literature cites studies on the applications of microcomputers. These include automotive, testing, navigation, instrumentation, biomedical, machine tools, and other applications. (This updated bibliography contains 370 abstracts, all of which are new entries to the previous edition.) GRA

**N78-31776#** National Technical Information Service, Springfield, Va.
**MICROCOMPUTERS. VOLUME 3, PART 2: TELECOMMUNICATION APPLICATIONS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Final Report, Mar. 1976 - Mar. 1978**
William E. Reed Jun. 1978 98 p Supersedes NTIS/PS-77/0328 and NTIS/PS-76/0204
(NTIS/PS-78/0613/6; NTIS/PS-77/0328; NTIS/PS-76/0204)
Avail: NTIS HC $28.00/MF $28.00 CSCL 09B

The bibliography of worldwide research literature cites studies in telecommunication applications of microcomputers. Telephone, data transmission, teleprinters, facsimile communication, and communications controllers are among the applications cited. (This updated bibliography contains 91 abstracts, 48 of which are new entries to the previous edition.) GRA

**N78-31777#** National Technical Information Service, Springfield, Va.
**MICROCOMPUTERS. VOLUME 3, PART 3: BASIC DESIGN AND DEVELOPMENT. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Final Report, Mar. 1976 - Mar. 1978**
George W. Reimherr Jun. 1978 243 p
(NTIS/PS-78/0614/4) Avail: NTIS HC $28.00/MF $28.00 CSCL 09B

The bibliography of worldwide research literature cites studies on the design and development of microcomputers. Studies on software development, chip development, LSI technology, and reliability and performance evaluation testing are included. (This updated bibliography contains 236 abstracts, none of which are new entries to the previous edition.) GRA

**N78-31778#** National Technical Information Service, Springfield, Va.
**MICROCOMPUTERS. VOLUME 4, PART 3: BASIC DESIGN AND DEVELOPMENT. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Final Report, Apr. 1977 - May 1978**
George W. Reimherr Jun. 1978 270 p Supersedes NTIS/PS-77/0329 and NTIS/PS-78/0610
(NTIS/PS-78/0615/1; NTIS/PS-77/0329; NTIS/PS-78/0610)
Avail: NTIS HC $28.00/MF $28.00 CSCL 09B

The bibliography of worldwide research literature cites studies on the design and development of microcomputers. Studies on software development, chip development, LSI technology, and reliability and performance evaluation testing are included. (This updated bibliography contains 263 abstracts, all of which are new entries to the previous edition.) GRA

**N78-31779#** National Technical Information Service, Springfield, Va.
**MICROCOMPUTERS. PART 4: PROCESS CONTROL APPLICATIONS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Final Report, 1970 - Mar. 1978**
Guy E. Habercom, Jr. Jun. 1978 97 p
(NTIS/PS-78/0616/9) Avail: NTIS HC $28.00/MF $28.00 CSCL 09B

Industrial applications of microcomputers to expedite processes were investigated in these reports gathered in a worldwide literature survey. Such diversified industries as pulp mills, rubber processing industry, chemical plants, metal fabrication plants, and machine shops were researched to ascertain the effectiveness of microcomputers as a process control tool. Comparative analyses of microcomputers and their control systems are made. GRA

**N78-31291*#** Bell-Northern Research Ltd., Ottawa (Ontario).
**A WIDE BANDWIDTH CCD BUFFER MEMORY SYSTEM**
K. Siemens, R. W. Wallace, and C. R. Robinson *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 9 p refs (For primary document see N78-31279 22-31)
(Contract NAS1-13507)
Avail: NTIS HC A21/MF A01 CSCL 09B

**N78-31292#** Bell-Northern Research Ltd., Ottawa (Ontario).
**A MICROPROCESSOR CONTROLLED ELECTRICALLY PROGRAMMABLE TRANSVERSAL FILTER**
A. Chowaniec, R. W. Wallace, M. A. Copeland (Carleton Univ., Ottawa), and Y. A. Haque (Carleton Univ., Ottawa) *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 9 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

# 61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

**N78-31780** Stanford Univ., Calif.
**ANALYSIS AND PERFORMANCE OF COMPUTER INSTRUCTION SETS Ph.D. Thesis**
Leonard Jay Shustek 1978 177 p
Avail: Univ. Microfilms Order No. 78-14208

Measurements of the characteristics of current use of digital computer instruction sets are analyzed. Some of the issues discussed are: opcode distributions, instruction length, branch analysis, branch and execution distance, opcode pair distributions, displacement values, address register utilization, operand lengths, cache memory effects, and pipeline breaks. Conclusions useful for future design evaluation are given. The results include conclusions about computer architectures and their implementations, as well as techniques generally applicable to studies of this type. Some of the data gathered is used as the basis for a model of the instruction fetch process; that model is solved analytically. Dissert. Abstr.

**N78-31781** Carnegie-Mellon Univ., Pittsburgh, Pa.
**MECHANICAL THEOREM PROVING AND ARTIFICIAL INTELLIGENCE LANGUAGES Ph.D. Thesis**
Mark Edward Stickel 1977 353 p
Avail: Univ. Microfilms Order No. 78-12160

Incomplete issues in the design of artificial intelligence languages are examined. Major sources of incompleteness are the pattern matching and inference facilities of the languages. Incompleteness in the area of pattern matching, repaired by developing unification algorithms for the specialized data types of the languages is reviewed. Incompleteness in the area of inference system, repaired by use of some form of the Pi inference procedures which is a complete extension derived from model elimination of the problem reduction method is discussed. The problem of compatibility of the Pi procedure and use of models is addressed though not finally resolved. Design of and experimental results for the theorem proving program PSTP are presented. The inference system used is a variant of the Pi procedure and a version of PSTP was used to verify the effectiveness of the special unification algorithms developed. Dissert. Abstr.

**N78-31782** California Univ., Berkeley. Lawrence Berkeley Lab.
**ON THE COMPLEXITY OF GRAMMAR AND LANGUAGE PROBLEMS Ph.D. Thesis**
Amiram Yehudai 1977 177 p
Avail: Univ. Microfilms Order No. 78-12833

A variety of problems relevant to Formal Language Theory are taken and their complexity is analyzed. Grammatical

transformations are discussed. The equivalence problem is considered. The complexity of deterministic context free languages is analyzed. Dissert. Abstr.

**N78-31783** Stanford Univ., Calif.
**TOPICS IN COMPUTATIONAL GEOMETRY Ph.D. Thesis**
John Edward Zolnowsky 1978 61 p
Avail: Univ. Microfilms Order No. 78-14222

The behavior of the nearest neighbor search algorithm based on the k-d tree data structure is presented. If S is a finite set of points in Euclidean k-space, and p is a point in S, the nearest neighbor of p in S is a member of S distinct from p which minimizes the distance from p. Bounds for the time for finding the nearest neighbor of all points using the k-d tree data structure are identified. Three different criteria for choosing the partition ordinate of each node in the k-d tree, based on the test point set are examined. An efficient algorithm for the construction of the intersection of a finite set of half-spaces in three dimensions is also presented. Dissert. Abstr.

**N78-31784** State Univ. of New York, Stony Brook.
**A REAL-TIME LANGUAGE OR SMALL PROCESSORS: DESIGN, DEFINITION, AND IMPLEMENTATION Ph.D. Thesis**
John LeRoy Hennessy 1977 265 p
Avail: Univ. Microfilms Order No. 7727468

Certain features of the real-time programming language TOMAL (Task-Oriented Microprocessor Applications Language) are discussed in detail. The most important of these is a multi-processing facility, called multi-tasking. A number of new concepts, particularly a new methodology for supporting I/O and device handling are introduced. The definition employing more than a single mode of description was chosen to define the entire language. The problem of feasibility is also addressed, demonstrating that the features designed are implementable. A major and new application of compile-time analysis is also presented. Dissert. Abstr.

**N78-31785** Purdue Univ., Lafayette, Ind.
**SYNTACTIC ALGORITHMS FOR IMAGE SEGMENTATION AND A SPECIAL COMPUTER ARCHITECTURE FOR IMAGE PROCESSING Ph.D. Thesis**
Janmin Keng 1977 264 p
Avail: Univ. Microfilms Order No. 7813073

Several algorithms for image recognition and segmentation and a new computer architecture for image processing are proposed. A finite-state string grammar is applied to the image recognition of highways, rivers, bridges, and commercial/industrial areas from LANDSAT images. A tree grammar is applied to the image segmentation of terrain and tactical targets from LANDSAT and infrared images respectively. The computer architecture proposed is a special purpose system in that it can perform an image processing task on several picture-points of an image at the same time, and thus takes advantage of the fact that image processing tasks usually exhibit parallelism. A parallel parsing scheme for tree grammar is used to demonstrate the higher efficiency of the proposed computer architecture than the conventional parsing scheme. Dissert. Abstr.

**N78-31786** California Univ., Berkeley.
**SPECIFICATION OF RELIABLE LARGE-SCALE SOFTWARE SYSTEMS Ph.D. Thesis**
Alex Paul Conn 1977 405 p
Avail: Univ. Microfilms Order No. 78-12530

Recent studies have revealed that a major source of difficulty in large-scale systems results from errors in the requirements specification and design of these systems. Research of the large-scale software development process is investigated. The transition between the requirements document and the start of the design and implementation processes is examined in particular. The principles underlying software specification were analyzed, and a system for computer entry, representation, and analysis of a specification language describing a target system was developed. The development of a specification/analysis system has progressed to the state of a prototype implementation design. The nature of the system as seen by the user was clearly identified. Extensive information and details on the syntax, semantics, representation, and analysis of the specification constructs were provided to enable the future implementation of a working system. Dissert. Abstr.

**N78-31787** Oakland Univ., Rochester, Mich.
**AN ADAPTIVE RECOGNITION ALGORITHM FOR THE AUTOMATIC DETECTION OF STRAIGHT LINE SEGMENTS Ph.D. Thesis**
Howard C. Crabb 1978 310 p
Avail: Univ. Microfilms Order No. 7814375

A recognition strategy which permits the detecting and encoding of straight lines used in engineering designs from conventional representation to compact digital form is developed. The program compression techniques that may be applied to drawings made up of lines developed from shape detecting as well as utilizing information-encoding techniques are reviewed. Nonlinear, isotropic picture functions are developed to examine subsets of the pixels of the digital picture and transform the image into a compact digital form. The recursive application of these functions to larger domains of definition is presented and tested. Thus processed, the lines detected may be stored on computer media in a highly compact form and are transmittable over existing switched network telephone lines more efficiently than is now possible with current electronic technology. Dissert. Abstr.

**N78-31788** Washington Univ., Seattle.
**PROGRAMMING BY ABSTRACTS DEMONSTRATION Ph.D. Thesis**
Gael Alan Curry 1978 179 p
Avail: Univ. Microfilms Order No. 78-14420

A new methodology, called programming by abstract demonstration (PAD), which uses demonstration for the specification of algorithms is described. Using it, a programmer constructs a program form as a side effect of an interactive, pictorial demonstration of the target algorithm. The target program is demonstrated on abstract data representing the class of inputs for which it is being designed. The program form so constructed can then be replayed on the same abstract data in order to review the program, or can be replayed on concrete input to produce a visible execution trace. Dissert. Abstr.

**N78-31789** California Univ., Berkeley.
**A MACHINE INDEPENDENT ALGORITHM FOR CODE GENERATION AND ITS USE IN RETARGETABLE COMPILERS Ph.D. Thesis**
Robert Steven Glanville 1977 130 p
Avail: Univ. Microfilms Order No. 78-12575

A method for the construction of efficient code generators for high-level procedural programming languages from a symbolic description of the instruction set of the target computer is presented. A table driven algorithm is given that translates a relatively low-level intermediate representation of a program into assembly or machine code for the target computer. A construction algorithm is presented that produces the required tables from a functional description of the target machine. By supplying an appropriate machine description, new tables can easily be created, thus retargeting a compiler for the new computer. Techniques are developed to prove the correctness of the resulting code generator based on the instruction set description. Dissert. Abstr.

**N78-31790** Stanford Univ., Calif.
**NUMERICAL ALGORITHMS FOR NONLINEARLY CONSTRAINED OPTIMIZATION Ph.D. Thesis**
Michael Thomas Heath 1978 149 p
Avail: Univ. Microfilms Order No. 7814175

The development and numerical implementation of algorithms for solving finite dimensional optimization problems are presented. A special emphasis is given to robustness, by which is meant the ability of an algorithm to cope with adverse circumstances, whether due to pathologies of a particular problem or to the shortcomings of finite precision computer arithmetic. A uniform framework is developed in which a common set of techniques may be applied to all of the standard problems of optimization. The algorithms are based on Newton-like methods implemented in a robust manner by means of hybrid, curved line searches and stable linear algebra techniques. Test results are presented

which show the validity and promise of the methods developed. Dissert. Abstr.

**N78-31791#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**VARIOUS ASPECTS FOR CORRECTING AND DETECTING SYNTACTICAL ERRORS IN COMPUTER PROGRAMS [ALGUNS ASPECTOS DA DETECCAO E CORRECAO DE ERROS SINTATICOS EM PROGRAMAS DE COMPUTADOR]**
Wilson Masami Miashiro and Flavio Roberto Dias Velasco Jul. 1977 18 p refs In PORTUGUESE; ENGLISH summary
(INPE-1063-NTE/098) Avail: NTIS HC A02/MF A01

The recovery of syntactical errors in computer programs is studied. This recovery consists in allowing the compiler to carry on the analysis of the program, even in the presence of syntactical errors, so that as many errors as possible are detected, in a single running of the program. If the origin of the detected error is known, its correction can be tried. As in the error correcting codes, the detection and correction of syntactical errors is closely related to the minimum distance among sentences of the language. The syntax of the programming language is modeled by a context-free grammar. Properties of the grammars, that guarantee the desired distance properties of the corresponding languages, are then investigated, particularly for 11(k) grammars. Author

**N78-31792*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**AN IMPROVED COMPUTATIONAL PROCEDURE FOR DETERMINING HELICOPTER ROTOR BLADE NATURAL MODES**
William H. Weller (Army Aviation Res. and Develop. Command, St. Louis, Mo.) and Raymond E. Mineck (Army Aviation Res. and Develop. Command, St. Louis, Mo.) Aug. 1978 88 p refs
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-78670; L-12046) Avail: NTIS HC A05/MF A01 CSCL 09B

An existing computer program, used for predicting the natural frequencies and mode shapes of helicopter rotor blades, was refined to improve program accuracy and versatility. The program is based on the Holzer-Myklestad approach adapted for rotating beams. Coupled vertical (out-of-plane), horizontal (in-plane), and torsional mode characteristics were determined for a variety of hub and blade configurations. The resulting program is documented by presenting the recursion equations and techniques for determining natural frequencies and mode shapes, input data requirements, and descriptions of various program outputs. The accuracy of the program is demonstrated by comparing computed results with exact solutions to classical problems and experimental data. G.G.

**N78-31793*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**SPAR DATA HANDLING UTILITIES**
Gary L. Giles and Raphael T. Haftka (Illinois Institute of Technology) Sep. 1978 50 p refs
(NASA-TM-78701; L-12106) Avail: NTIS HC A03/MF A01 CSCL 09B

The SPAR computer software system is a collection of processors that perform particular steps in the finite-element structural analysis procedure. The data generated by each processor are stored on a data base complex residing on an auxiliary storage device, and these data are then used by subsequent processors. The SPAR data handling utilities use routines to transfer data between the processors and the data base complex. A detailed description of the data base complex organization is presented. A discussion of how these SPAR data handling utilities are used in an application program to perform desired user functions is given with the steps necessary to convert an existing program to a SPAR processor by incorporating these utilities. Finally, a sample SPAR processor is included to illustrate the use of the data handling utilities. G.G.

**N78-31794*#** Vought Corp., Hampton, Va.
**MODELING OF A LATENT FAULT DETECTOR IN A DIGITAL SYSTEM**
Phyllis M. Nagel Sep. 1978 28 p refs
(Contract NAS1-13500)
(NASA-CR-145371) Avail: NTIS HC A03/MF A01 CSCL 09B

Methods of modeling the detection time or latency period of a hardware fault in a digital system are proposed that explain how a computer detects faults in a computational mode. The objectives were to study how software reacts to a fault, to account for as many variables as possible affecting detection and to forecast a given program's detecting ability prior to computation. A series of experiments were conducted on a small emulated microprocessor with fault injection capability. Results indicate that the detecting capability of a program largely depends on the instruction subset used during computation and the frequency of its use and has little direct dependence on such variables as fault mode, number set, degree of branching and program length. A model is discussed which employs an analog with balls in an urn to explain the rate of which subsequent repetitions of an instruction or instruction set detect a given fault. Author

**N78-31795*#** M and S Computing, Inc., Huntsville, Ala.
**RSX-11D/DX11-B INTERFACE USER'S GUIDE**
23 Aug. 1978 25 p
(Contract NAS8-31949)
(NASA-CR-150809; Rept-78-084) Avail: NTIS HC A02/MF A01 CSCL 09B

A functional description of the DX interface subsystem is given and the commands, procedures, and conventions for its use are described. The manual is divided into the following topics: (1) an overview of the subsystem; (2) guidelines on writing user programs which communicate with IBM 360/370 via the DX11-B interface; (3) the requirements for maintaining and using the DX11-B device handler; (4) considerations for enabling the IBM 360/370 to use the device emulated by the PDP-11/DX11-B; and (5) a guide for isolating system faults. J.M.S.

**N78-31796#** Army Missile Research and Development Command, Redstone Arsenal, Ala. Technology Lab.
**COMPUTER SOFTWARE FOR ANALYSIS OF INFRARED TARGETS AND CLUTTER**
Gene E. Gowins and H. Jackson Jan. 1978 127 p refs
(AD-A054235; DRDMI-T-78-33) Avail: NTIS HC A07/MF A01 CSCL 17/5

This report is the second in an anticipated series of progress reports on target/background modeling related to the US Army Missile Research and Development Command's Target Signature Program. This report describes data collection and computer software used to characterize infrared targets and clutter in the 3 to 5 micron and 8 to 14 micron infrared spectrum. A raster type scanner Thermovision system is used to collect 10,000 data points per infrared picture. These Thermovision data points provide input to several different types of computer software routines used to investigate and evaluate passive infrared targets and clutter signatures and identify potential target discrimination and acquisition techniques. Author (GRA)

**N78-31797#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**PRELIMINARY DESIGN FOR MULTIMODE MATRIX PERCEPTION EXPERIMENT SOFTWARE M.S. Thesis**
Stefan G. Wenska Dec. 1977 155 p refs
(AD-A055178; AFIT/GCS/EE/77-11) Avail: NTIS HC A08/MF A01 CSCL 09/2

The Multi-Mode Matrix Display Program is testing the acceptability of using light-emitting diode displays in USAF aircraft. The preliminary design for the software was done by following a method which enhances software maintainability. The method uses abstracts data types, data flow diagrams, and structured design techniques to produce a complete design for the system. The software design is presented using structure charts together with functional descriptions of all modules and definitions of the interfaces between modules. Author (GRA)

**N78-31798#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**SIMULATION OF THE DIRECT EXECUTION OF A HIGHER ORDER LANGUAGE**

David L. Akin and Brian C. Allen Mar. 1978 229 p refs
(AD-A055235; AFIT/GCS/EE/78-1) Avail: NTIS HC A11/MF A01 CSCL 09/2

This thesis lists the results of a follow-on study of Phase 2 of the Space Programming Language Machine (SPLM) Architecture Study (AD-A002 798). In this follow-on study, the Clock Level Simulator (CLS) was translated to JOVIAL/J73 and improvements were made to decrease execution times and memory requirements of the simulator. This work was accomplished using the DEC-10 system of the AF Avionics Lab. at Wright-Patterson AFB. CLS simulates the direct execution of SPLML (Space Programming Language Machine Language) on an SPLM. SPLML is a higher order language that was developed especially for avionic applications. CLS was developed as a design tool where the memory word size, memory address size, etc. are design parameters which represents a specific configuration of an SPLM. CLS, therefore, is a preliminary model for a family of machines (SPLM) with varying capabilities and complexities. An example program execution is given in detail. GRA

**N78-31799#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

**TRUTH MAINTENANCE SYSTEMS FOR PROBLEM SOLVING**

Jon Doyle Jan. 1978 132 p refs
(Contract N00014-75-C-0643)
(AD-A054826; AI-TR-419) Avail: NTIS HC A07/MF A01 CSCL 06/4

The thesis developed in this paper is that reasoning programs which take care to record the logical justifications for program beliefs can apply several powerful, but simple, domain-independent algorithms to: (1) maintain the consistency of program beliefs; (2) realize substantial search efficiencies; and (3) automatically summarize explanations of program beliefs. This report describes techniques for representing, recording, maintaining, and using justifications for beliefs. Also presented is an annotated implementation of a domain-independent program. GRA

**N78-31800#** Army Armament Research and Development Command, Aberdeen Proving Ground, Md. Ballistics Research Lab.

**INTERPOL: AN INTERACTIVE PLOTTING PACKAGE FOR OFF-LINE CAL COMP SYSTEMS Final Report**

R. M. Schwenk, J. W. Kinch, and A. E. Raines Mar. 1978 46 p
(DA Proj. 1W1-62118-AH-75)
(AD-A054762; AD-E430024; ARBRL-MR-02818) Avail: NTIS HC A03/MF A01 CSCL 09/2

INTERPOL computer program, Cal Comp plotters, PE62118 A, ASH7527 The interpol Interactive Plotting for Off- Line systems program has been written to incorporate the necessary routines required for general purpose two-dimensional and three-dimensional x,y data plotting. The interactive format of the program reduces the typical three-step planning, writing, and debugging process to an efficient, single-step question and answer execution. The plotting routines employed are standard Cal Comp FORTRAN sub-programs for off-line Cal Comp pen plotters. Driver routines and miscellaneous I/O routines all use standard FORTRAN. This program may be used with TTY and CRT type terminals. Foreknowledge of computer plotting techniques is not necessary, although some experience may be helpful. GRA

**N78-31801#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

**THE DISCOURSE AND REFERENCE COMPONENTS OF PAL Progress Report**

Candace Sidner Apr. 1978 19 p refs
(Contract N00014-75-C-0643)
(AD-A055046; AI-M-468) Avail: NTIS HC A02/MF A01 CSCL 09/2

This paper reports on research being conducted on a computer assistant, called PAL. PAL is being designed to arrange various kinds of events with concern for the who, what, when, where and why of that event. The goal for PAL is to permit a speaker to interact with it in English and to use extended discourse to state the speaker's requirements. The portion of the language system discussed in this report disambiguates references from discourse and interprets the purpose of sentences of the discourse. PAL uses the focus of discourse to direct its attention to a portion of the discourse and to the database to which the discourse refers. The focus makes it possible to disambiguate references with minimal search. Focus and a frames representation of the discourse make it possible to interpret discourse purposes. The focus and representation of the discourse are explained, and the computational components of PAL which implement reference disambiguation and discourse interpretation are presented in detail. Author (GRA)

**N78-31802#** Texas Univ. at Austin. Center for Cybernetic Studies.

**A DUAL OPTIMIZATION FRAMEWORK FOR SOME PROBLEMS OF INFORMATION THEORY AND STATISTICS**

A. Ben-Tal (Technion - Israel Inst. of Technol.) and A. Charnes Nov. 1977 27 p refs
(Contract N00014-75-C-0569; NR Proj. 047-021)
(AD-A055155; CCS-310) Avail: NTIS HC A03/MF A01 CSCL 12/11

A new dual optimization framework for some problems of information theory and statistics is developed in the form of dual convex programming problems and their duality theory. It extends the work for finite discrete distributions to the case of general measures. Although the primal problem (constrained relative entropy) is an infinite dimensional one, the dual problem is a finite dimensional one without constraints and involving only exponential and linear terms. Applications range from mathematical statistics and statistical mechanics to traffic engineering, marketing and economics. GRA

**N78-31803#** Texas Univ. at Austin. Center for Cybernetic Studies.

**A NEW CLASS OF FEASIBLE DIRECTION METHODS**

A. Ben-Tal and S. Zlobec Sep. 1977 49 p refs
(Contracts N00014-67-A-0126-0009; N00014-75-C-0569)
(AD-A055032; CCS-311) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper introduces a new class of feasible direction methods for solving differentiable convex programs with nonlinear convex constraints. The ones introduced here are based on two recent characterizations of optimality without a constraint qualification. The new methods are capable of generating feasible directions of descent along the boundary of the feasible set and they consistently give directions of steeper descent than many popular methods. This is achieved by solving only one linear program at each iteration. The new methods are particularly useful in solving large sparse convex programs; some of the programs tested had 100 variables and 50 nonlinear constraints. Morever, the new methods are applicable whether or not Slater's condition or any other constraint qualification is satisfied. GRA

**N78-31804#** Computer Sciences Corp., Huntsville, Ala.

**HOL CODE GENERATOR DEVELOPMENT METHODOLOGY Final Report**

J. W. Crenshaw and D. R. Griffin 8 Nov. 1977 70 p
(Contract DAAK40-77-C-0048)
(AD-A055383; CSC/TR-77/549615) Avail: NTIS HC A04/MF A01 CSCL 09/2

On the basis of the analyses presented in this report, it appears that it is feasible to modify an existing HOL to provide low-cost retargeting, without severely degrading the object-time execution efficiency. Some specific recommendations include: (1) The compiler chosen must have an architecture such that there is both a well-defined intermediate language (IL) and a modular code generator (CG); an IL composed of triplets or quadruples is preferred; (2) The compiler chosen must have extensive capability to perform global optimization. It is suggested that existing capabilities be enhanced to include code straightening, dead variable analysis, and loop optimizations. The important area of register management should be performed in a parametric manner, so that retargeting can be accomplished by loading a table of machine parameters; (3) The code generator should output a character string consisting of assembly language for the target machine; assembly and linking shall be accomplished off-line by separate software; and (4) At least one extra level of IL should be considered. GRA

**N78-31805#** Naval Ocean Systems Center, San Diego, Calif.
**FUNCTIONAL DESCRIPTION OF A VALIDATION TOOL FOR CMS-2 SOFTWARE**
R. N. Goss 1 Feb. 1978 16 p
(AD-A055973; NOSC/TD-138) Avail: NTIS HC A02/MF A01 CSCL 09/2

This document sets forth the requirements for a set of computer programs yielding information about tests made on CMS-2 software. This set of programs is called a validation tool. A validation tool, depending on the needs of the investigator, can be made as sophisticated as required at the expense of additional memory and running time. The validation tool proposed here is primarily for static analysis. Author (GRA)

**N78-31806#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**SOFTWARE TOOL (S) FOR EVALUATING THE EFFECTS OF FINITE WORDLENGTH M.S. Thesis**
Gary A. Klein Dec. 1977 186 p refs
(AD-A055777; AFIT/GCS/EE/77-6) Avail: NTIS HC A09/MF A01 CSCL 09/2

In developing estimation and control systems, the algorithms developed are, in general, very sensitive to the wordlength of the onboard computer. Representation of the desired design can be greatly affected by the quantization resulting from truncation or round off. The result can be even more severe than numerical imprecision: numerical instability can be generated that render algorithms totally useless. An important part of algorithm development is determining the appropriate wordlength. Proper wordlength can be determined by running the algorithm on a simulated n-bit machine for several values of n; Results can then be evaluated against performance specification to determine the wordlength and precision requirements. The objective of this thesis was to process algorithms written in FORTRAN on the CDC 6600/CYBER 74 computer systems such that the results obtained were similar to those obtainable on an n-bit machine. A preprocessor was designed which would modify the algorithm's code so that the numerical effects of n-bit wordlength could be realized. An n-bit simulation tool was successfully developed and implemented at the FORTRAN level. GRA

**N78-31807#** Southeastern Massachusetts Univ., North Dartmouth. Dept. of Electrical Engineering.
**SOME NEW RESULTS ON IMAGE PROCESSING AND RECOGNITION**
C. H. Chen 12 Jun. 1978 12 p refs
(Grant AF-AFOSR-2951-76)
(AD-A055862; EE-78-4; AFOSR-78-1106TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

A brief review is made of current problems on computer image processing and recognition. New and unpublished results of a rotation-invariant operator and an adaptive filtering approach are then presented. Finally, a sequential binary decision procedure for reconnaissance image classification is discussed.
Author (GRA)

**N78-31808#** Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
**AN ANNOTATED BIBLIOGRAPHY OF NATURAL LANGUAGE AND SPEECH UNDERSTANDING SYSTEMS Interim Report**
John R. Kender Dec. 1977 61 p refs
(Contract F44620-73-C-0074)
(AD-A055863; AFOSR-78-1093TR) Avail: NTIS HC A04/MF A01 CSCL 05/7

This annotated bibliography summarizes some 80 papers dealing with various aspects of natural language and speech understanding systems. Most detail a working system which 'understands' 'natural' input. Stress is on those issues at or above the level of syntax. Also included are several overviews and criticisms, usually in the form of comparative studies.
Author (GRA)

**N78-31809#** System Development Corp., Santa Monica, Calif.
**SOFTWARE ACQUISITION MANAGEMENT GUIDEBOOK: COST ESTIMATION AND MEASUREMENT**
Marsha Finfer and Russell Mish Mar. 1978 112 p refs
(Contract F19628-76-C-0236)
(AD-A055574; SDC-TM-5772/007/02; ESD-TR-78-140) Avail: NTIS HC A06/MF A01 CSCL 17/2

The Software Cost Estimation and Measurement guidebook is designed to assist Air Force personnel who are responsible for estimating and controlling the costs of embedded software within command, control, and communications systems. It provides a basic understanding of the current methodologies used in the formation of Air Force and contractor software cost estimates. Insight is provided into some of the problems (and reasons for the problems) associated with software cost estimates made by both Government and industry. The guidebook discusses the role of parametric models used in cost estimation and reviews three experimental predictive models. It also discusses the process of monitoring software costs and schedules while providing guidance to relevant military regulations, specifications, standards, and supporting literature. Much of the information and guidance provided is applicable to smaller less complex systems, but in all cases, it should be tailored to the needs of individual projects. Author (GRA)

**N78-31810#** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
**A FORMAL APPROACH TO DISCOURSE ANAPHORA**
Bonnie Lynn Webber May 1978 194 p refs
(Contract N00014-77-C-0378; ARPA Order 3414)
(AD-A055671; BBN-3761) Avail: NTIS HC A09/MF A01 CSCL 05/7

Extended natural language communication between a person engaged in solving a problem or seeking information and a machine providing assistance requires the machine to be able to deal with anaphoric language in a perspicuous, transportable non-ad hoc way. This report takes the view that dealing with anaphoric language can be decomposed into two complementary tasks: (1) identifying what a text potentially makes available for anaphoric reference; and (2) constraining the candidate set of a given anaphoric expression down to one possible choice. The second task has been called the 'Anaphor resolution' problem and, to date, has stimulated much research in psychology and artificial intelligence natural language understanding. The focus of this report is the first task - that of identifying what a text makes available for anaphoric reference and how it does so. GRA

**N78-31811#** Fondazione Ugo Bordoni, Rome (Italy).
**IMPLEMENTATION OF ALGORITHMS FOR PERFORMANCE ANALYSIS OF A CLASS OF MULTIPROGRAMMED COMPUTERS**
Mauro Brizzi and Davide Gillo Apr. 1977 22 p refs Presented at the 3d Intern. Symp. on Modeling and Performance Evaluation of Computer Systems, Bonn, 3-5 Oct. 1977
(FUB-25-1977) Avail: NTIS HC A02/MF A01

The description of a package for the numerical evaluation of queueing networks performance figures is presented. The package is based on the application of the generating function approach for analyzing models characterized by product form solutions. Output performance figures are: utilization, throughput, queue length, job renewal rate, and response time. The package pursues flexibility in modelling the network, efficiency in terms of running time, and control over the detail level in investigating network behavior. Author (ESA)

**N78-31812#** National Bureau of Standards, Washington, D. C.
**COMPUTER SCIENCE AND STATISTICS: ANNUAL SYMPOSIUM ON THE INTERFACE Final Report**
David Hogben and Dennis W. Fife Mar. 1978 468 p refs Presented at the 10th Ann. Symp. NBS, Gaithersburg, Md., 14-15 Apr. 1977
(Grant NSF MCS-77-04441)
(PB-280370/8; NBS-SP-503) Avail: NTIS HC A20/MF A01 CSCL 09B

Papers were presented in six workshops on Evaluation of Statistical Software, Nonlinear models, Graphics, Large Data Files, Numerical Analysis in Statistics, and Maintenance and Distribution of Statistical Software. The Evaluation of Statistical Software Workshop was divided into two sessions on Statistical Program packages for Small Computers and Computing Approaches to the Analysis of Variance for Unbalanced Data. GRA

**N78-31813#** Mathematics and Computation Lab., Washington, D. C.

**MAPS: A MATRIX ARITHMETIC PROGRAMMING SYSTEM Final Report**
Mar. 1978 71 p
(PB-279859/3; GSA/FPA/MCL-TM-262) Avail: NTIS HC A04/MF A01 CSCL 09B

The Matrix Arithmetic Programming System (MAPS) is a programming language developed to give users the capability to manipulate vectors and matrices. The organization and design of MAPS, how to use MAPS (including a directory of MAPS instructions), and several sample MAPS runs are described. GRA

# 62 COMPUTER SYSTEMS

Includes computer networks.

**N78-31814** Connecticut Univ., Storrs.
**COMPUTATION EXPRESSIONS AND THEIR APPLICATIONS IN AN ADAPTIVE COMPUTER SYSTEM Ph.D. Thesis**
Martin Chien-Ming Wei 1978 219 p
Avail: Univ. Microfilms Order No. 7813863

Inherent parallelism in the control structure of a computation is proposed as a controlling factor for adapting the expected execution time performance of a program to a prespecified performance level. To accomplish this, a computation expression was defined and developed for modeling computations. Algorithms were developed to transform serial form computations into equivalent n-parallel form computations. Analytical techniques were also developed to compute the expected execution time of a computation directly from its computation expression model. A Multiple Instruction Stream - Multiple Data Stream computer architecture is also proposed as one of the possible hardware organizations for allowing executions of parallel computations. Dissert. Abstr.

**N78-31815** Michigan Univ., Ann Arbor.
**MODELLING PARALLEL SYSTEMS WITH DYNAMIC STRUCTURE Ph.D. Thesis**
Jack Craig Wileden 1978 256 p
Avail: Univ. Microfilms Order No. 78-13756

A formal modelling scheme, the Dynamic Process Modelling Scheme capable of describing parallel systems with dynamic structure in general is defined. The scheme is based upon an abstract programming language, called DYMOL, and a technique for representing the changing configurations of a dynamically-structured system. Formal semantics for DYMOL link the modification of a system's configuration over time to the activities of system components. Examples in the dissertation illustrate the potential usefulness of the modelling scheme is designing and analyzing dynamically-structured concurrent software systems. Dissert. Abstr.

**N78-31816** Stanford Univ., Calif.
**STOCHASTIC MODELLING OF COMPUTER SYSTEMS AND NETWORKS Ph.D. Thesis**
Philip Shi-lung Yu 1978 218 p
Avail: Univ. Microfilms Order No. 78-14221

The performance analysis of computer systems and networks are addressed. The distribution of passage times for the closed queueing networks whose equilibrium state probabilities are available were derived. An efficient numerical approximation was also developed. The result on the closed queueing network was further extended to obtain approximate passage time distributions for the open queueing networks. Then the techniques were employed to study the interfault time and response time distribution functions and density functions of multiprogrammed paging computer systems. Dissert. Abstr.

**N78-31817** Iowa State Univ. of Science and Technology, Ames.
**MEMORY MANAGEMENT POLICIES FOR A HARDWARE IMPLEMENTED COMPUTER OPERATING SYSTEM Ph.D. Thesis**
William A Kwinn 1978 75 p
Avail: Univ. Microfilms Order No. 78-13235

Two features of computer systems developed to expand the scope of practically addressable problems are virtual memory and dynamic memory management. Unfortunately, these two features can interact to degrade performance because the scattering of memory references can be aggravated by dynamic allocation of storage, causing a large number of page faults during program execution. The purpose of this research is to demonstrate techniques which reduce these harmful interactions. The techniques suggested were successfully implemented on the SYMBOL-2R computer system. Dissert. Abstr.

**N78-31818*#** Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
**A FAULT-TOLERANT MULTIPROCESSOR ARCHITECTURE FOR AIRCRAFT, VOLUME 1 Topical Report, May 1976 - Apr. 1976**
T. B. Smith, A. L. Hopkins, W. Taylor, R. A. Ausrotas, J. H. Lala, L. D. Hanley, and J. H. Martin Jul. 1978 228 p refs (Contract NAS1-13782)
(NASA-CR-3010; R-1140-Vol-1) Avail: NTIS HC A11/MF A01 CSCL 09B

A fault-tolerant multiprocessor architecture is reported. This architecture, together with a comprehensive information system architecture, has important potential for future aircraft applications. A preliminary definition and assessment of a suitable multiprocessor architecture for such applications is developed. G.G.

**N78-31819*#** Texas Instruments, Inc., Dallas. Equipment Group.
**THE DESIGN AND DEMONSTRATION OF AN ADVANCED DATA COLLECTION/POSITION LOCATING SYSTEM, ADDENDUM Final Report, Oct. 1977 - Apr. 1978**
May 1978 127 p refs
(Contract NAS5-23599)
(NASA-CR-156813) Avail: NTIS HC A07/MF A01 CSCL 09B

The theoretical background for a coherent demodulator for minimum shift keying signals generated by the advanced data collection/position locating system breadboard is presented along with a discussion of the design concept. Various tests and test results, obtained with the breadboard system described, include evaluation of bit-error rate performance, acquisition time, clock recovery, recycle time, frequency measurement accuracy, and mutual interference. A.R.H.

**N78-31820#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**A DISTRIBUTED MINI-COMPUTER NETWORK M.S. Thesis**
R. Cade Adams Dec. 1977 93 p refs
(AD-A055254; AFIT/GCS/EE/77-4) Avail: NTIS HC A05/MF A01 CSCL 09/2

This thesis presents a set of functional requirements for a distributed mini-computer network along with a basic architecture design to fulfill those requirements. The functional requirements were established by comparing the requirements of existing networks to the needs of the Air Force Institute of Technology Digital Engineering Laboratory. The requirements must provide a tool for education in operating systems studies while allowing mini-computer-based research. The primary emphasis of the proposed architecture is the separation of the network operating system functions into independent processes which will run concurrently on the various mini-computers in the network. This distribution of network supervisory functions is made possible by limiting all communication between processes to a set of synchronizing messages. The messages provide a data interface which allows communication without knowledge of the processes location within the network. GRA

**N78-31821#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Hauptabt. Rechenzentrum.
**BACKGROUND STORAGE MANAGEMENT IN OPERATING SYSTEMS FOR COMMUNICATION COMPUTERS M.S. Thesis - Tech. Univ. Munich**
Michail Melnikow 22 Aug. 1977 56 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-500)
(DLR-FB-77-37) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 30,20

The development of a background storage management system adapted to special purposes of communications computers is presented. Starting from the different possibilities of using background storage in communications computer problems the architecture of a background storage management system is developed. This architecture is described by a model consisting of three parts: storage management, and data management, data access methods. The file concept was investigated more closely and formulated with respect to the organization of data on background storages. Using these basic ideas the structures and strategies of the various components of the model are demonstrated. The storage management system (PLADAT implementdd on the communication computer TR86S) is described in more detail, other possible realizations are mentioned.
Author (ESA)

**N78-31822#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Hauptabt. Rechenzentrum.
**LINK INVARIANT LINE PROGRAMS IN COMMUNICATION SYSTEMS M.S. Thesis - Tech. Univ. Munich**
Franz Josef Buchberger 22 Aug. 1977 89 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-501)
(DLR-FB-77-38) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 42,30

Starting from the term 'communication system' a general introduction to the field of communication operating systems is given. Guided by two examples; the operational programs of the IMPs and TIPs in the ARPA computer network and the operating system SOHO, it is shown how communication operating systems can be constructed in detail. The line programs are considered in particular. The terms 'simple', 'copied' and 'link invariant' line program are defined, and the advantages and disadvantages of these types of line programs are discussed. The implementation of link invariant line programs in the operating system SOHO is described. Their memory space and computing time requirements are evaluated. Furthermore, the effect of these requirements on the overall system performance is investigated. The investigation shows that the link invariant line programs are preferable to copied line programs in most cases.
Author (ESA)

**N78-31823#** National Bureau of Standards, Washington, D. C. Inst. for Computer Sciences and Technology.
**COMPUTER SCIENCE AND TECHNOLOGY: LOCAL AREA NETWORKING. REPORT OF A WORKSHOP**
Ira W. Cotton Apr. 1978 94 p refs Conf. held at the NBS, Gaithersburg, Md., 22-23 Aug. 1977
(PB-279921/1; NBS-SP-500-31) Avail: NTIS HC A05/MF A01 CSCL 09B

The sessions were as follows: (1) subnet architecture; (2) protocols for local area networks; (3) local network applications; (4) network architecture; (5) network operating systems; and (6) analysis and performance evaluation. GRA

## 63 CYBERNETICS

Includes feedback and control theory.
For related information see also *54 Man/System Technology and Life Support*.

**N78-31824** California Univ., Los Angeles.
**AN M/M/1 DYNAMIC PRIORITY QUEUE WITH OPTIONAL PROMOTION Ph.D. Thesis**
Ehud Kofman 1978 48 p
Avail: Univ. Microfilms Order No. 7811360

An M/M/1 queue with two types of customers: priority customers and regular customers is considered. They arrive at the service facility according to two independent Poisson streams, and they form a single queue according to the order in which they arrive. The two types of customers are distinguished by the holding costs charged per unit time that each of them resides in the queue. The server can either serve customers according to the order in which they arrive or pay a fixed fee and promote a priority customer, thereby bypassing the customers ahead of him. The queue controller selects the customers to be served so as to minimize the expected costs of operating the system. The problem is formulated as a Markov Decision Process and the criterion of optimality employed is average cost per unit of time. Dissert. Abstr.

**N78-31825*#** Systems Research Lab., Champaign, Ill.
**DIGITAL CONTROLLER DESIGN: ANALYSIS OF THE ANNULAR SUSPENSION POINTING SYSTEM Bi-monthly Report**
B. C. Kuo 1 Sep. 1978 26 p
(Contract NAS8-32358)
(NASA-CR-150807) Avail: NTIS HC A03/MF A01 CSCL 09B

The analog controllers of the annular suspension pointing system are designed for control of the chi, phi sub 1, and phi sub 2 bandwidth dynamics through decoupling and pole placement. Since it is virtually impossible to find an equivalent bandwidth of the overall system and establish a general eigenvalue requirement for the system, the subsystem dynamics are decoupled through state feedback and the poles are placed simultaneously to realize the desired bandwidths for the three system components. Decoupling and pole placement are also used to design the closed-loop digital system through approximation. J.M.S.

**N78-31826#** Technology Service Corp., Santa Monica, Calif.
**MULTIDOMAIN ALGORITHM EVALUATION, VOLUME 1 Final Technical Report, 25 Jun. 1976 - 18 Oct. 1977**
William C. Liles, James C. Demmel, Irving S. Reed, John D. Mallett, and Lawrence E. Brennan Griffiss AFB, N.Y. RADC Apr. 1978 271 p refs 2 Vol.
(Contract F30602-76-C-0319; AF Proj. 4506)
(AD-A054357; TSC-PD-B525-1-Vol-1; RADC-TR-78-59-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 17/9

The purpose of this study is to evaluate different algorithms for solving for up to 200 adaptive weights in an adaptive array radar, using the sample covariance matrix inversion technique. The sample covariance matrix inversion technique was studied because of its ability to handle adaptation in many domains, i.e., spatial, temporal, and polarization. The algorithms and their implementations on different computer architectures, such as associative, parallel, vector pipeline, and sequential, are considered. Both theoretical timings and actual timings on currently available machines are obtained. Major conclusions reached are that because of the strong dependence of an algorithm's implementation on the computer architecture, it is not possible to choose the best algorithm by operation counts; it is possible to greatly improve system performance by using separate processors to perform the covariance matrix computation and weight calculations; parallel complex arithmetic implemented in hardware would greatly improve a system's performance; and associativity is not useful for this problem. Finally, an architecture designed specifically for solving for adaptive weights is outlined. Author (GRA)

**N78-31827#** Technology Service Corp., Santa Monica, Calif.
**MULTIDOMAIN ALGORITHM EVALUATION, VOLUME 2 Final Technical Report, 25 Jun. 1976 - 18 Oct. 1977**
William C. Liles, James C. Demmel, Irving S. Reed, John D. Mallett, and Lawrence E. Brennan Griffiss AFB, N.Y. RADC Apr. 1978 269 p 2 Vol.
(Contract F30602-76-C-0319; AF Proj. 4506)
(AD-A054358; TSC-PD-B525-1-Vol-2; RADC-TR-78-50-Vol-2) Avail: NTIS HC A12/MF A01 CSCL 17/9

This document contains appendices for volume 1. GRA

**N78-31828#** Optical Sciences Co., Placentia, Calif.
**ADAPTIVE COMPENSATION TECHNIQUES Final Technical Report, Jun. 1977 - Feb. 1978**
David L. Fried, Emil J. Schonheinz, and Robert B. Asher May 1978 392 p refs
(Contract F30602-77-C-0099)
(AD-A055177; DR-105; RADC-TR-78-101) Avail: NTIS HC A17/MF A01 CSCL 17/8

This report is the final technical report on work performed on Contract F30602-77-C-0099, and covers all work done under this contract. This report presents analysis, a set of computer simulation programs, and a set of simulation results that demonstrate that an adaptive compensation pointing and tracking

servo loop can be closed in a long range space engagement that permits high servo bandwidth tracking performance with point-ahead and boresight error compensation that adapts to insure that the laser spot is held on the desired aimpoint. A laser spot position technique based on exploitation of speckle statistics is developed that allows the true laser spot position to be sensed and compensated for whether or not a glint point (even a strong glint point) is present. Simulation results demonstrate the performance at the concept and lead to the conclusion that the technique should be applicable with extension, to higher order adaptive optics control problems - thus providing high servo bandwidth performance together with compensation for any bias errors. Author (GRA)

**N78-31829#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**AN ANALYSIS OF OBSERVED SYSTEM SENSITIVITY TO PLANT PARAMETER VARIATIONS M.S. Thesis**

Dennis Larry Hamme Mar. 1978 64 p refs

(AD-A055190; AFIT/GGC/EE/78-1) Avail: NTIS HC A04/MF A01 CSCL 12/1

State-variable feedback is a modern control theory technique that is employed in system design to place closed-loop poles to achieve desired performance characteristics. Two problems associated with state-variable feedback are physical inaccessibility to plant states and output sensitivity to plant parameter variations. In this report an observer is employed to reconstruct all plant states. The plant-observer system is investigated with respect to sensitivity aspects of the following three areas: state-variable representation, extent of pole placement, and observer dynamics design. A comparison between physical, phase, and Jordan canonical variables indicated physical and phase variable representations yield identical sensitivity functions; Jordan canonical variables result in greater sensitivity than physical and phase variables. Placing plant poles close together creates a high system sensitivity to plant parameter variations; separation of poles reduces sensitivity. As a minimal requirement for low system sensitivity, observer poles should be placed to the left of dominant plant poles; further reductions in sensitivity are achieved by placing observer poles to the left of all plant poles. Author (GRA)

**N78-31830#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**VALIDATION OF CLOSED QUEUEING NETWORK MODELS FOR THE DECsystem-10 M.S. Thesis**

Harold E. Saxton Mar. 1978 136 p refs

(AD-A055118; GCS/EE/77-7) Avail: NTIS HC A07/MF A01 CSCL 09/2

A validation study was performed on Closed Queueing Network Models for the DECsystem-10 located at the Air Force Avionics Laboratory (AFAL). The purpose of this study was to provide the personnel of AFAL with an understanding of the accuracy with which this class of model can predict computer performance. A previously developed FORTRAN program was used to implement the product form solution and the computational algorithms required for performance evaluation. A review of the solution technique is presented with a discussion of the consequences resulting from assumptions required to arrive at the closed form solution. The validation results are described for a series of experiments which investigated the accuracy of the models for several system configurations and under a variety of workloads. These results indicate that Closed Queueing Network Models are a flexible means of representing the DECsystem-10 and that the product form solution provides performance predictions which are useful for evaluation of the system. Author (GRA)

**N78-31831#** Stanford Univ., Calif. Dept. of Operations Research.

**REGENERATIVE SIMULATION OF RESPONSE TIMES IN NETWORKS OF QUEUES II MULTIPLE JOB TYPES**

Donald L. Iglehart and Gerald S. Shedler Jun. 1978 35 p refs

(Contract N00014-76-C-0578; Contract NSF MCS-75-23607) (AD-A055584; TR-48) Avail: NTIS HC A03/MF A01 CSCL 12/2

The writers have previously discussed the simulation of networks of queues for general characteristics of passage times of a single job type, using the regenerative method for simulation and the idea of tracking a distinguished job through the network. In this paper, they consider from a somewhat different point of view, passage time simulation in closed networks for queues having multiple job types. Their results provide a means of obtaining, from a single replication, point and interval estimates for passage times of the several job types. They also yield a statistically more efficient estimation procedure for passage times of a single job type. GRA

**N78-31832#** Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires at Geophysiques.

**ON THE DUAL-ADAPTIVE CONTROL AND ITS PRACTICAL APPLICATIONS**

O. Badr, D. Rey, and P. Ladet 28 Nov. 1977 16 p refs Submitted for publication

(CEPHAG-52/77) Avail: NTIS HC A02/MF A01

The dual adaptive control algorithm of Alster and Belanger is discussed and possible difficulties related to its practical application are pointed out. This discussion leads to a proposal for a modified algorithm which can be applied to multivariable systems. A comparison between the proposed algorithm and the certainty equivalent one shows the efficiency of the proposed algorithm, especially when the initial parameter estimates are poor. It was also tested on the pilot distillation process of the Automatic Control Laboratory at Grenoble. Author (ESA)

**N78-31833#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

**INVESTIGATIONS OF SELF ORGANIZING CONTROL LAWS AND POSSIBILITIES OF THEIR REALIZATION**

Hans-Juergen Schnittger 28 Dec. 1977 47 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-519)

(Contract DFG-BR-542/1)

(DLR-FB-77-57) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 24,30

Two principles for the control of nonlinear processes and processes with high parameter variation were investigated. The first method allows to suppress boundary oscillations in nonlinear control loops. It is also known as 'method of statistical linearization'. The second one is an optimization procedure based on a search algorithm. The optimization goal is to strike rapidly a switching line in the state plane on which the system behavior is independent of the process parameters. The method permits to observe and to counteract sudden changes of the process gain polarity. Author (ESA)

## 64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

**N78-31834** North Carolina Univ. at Chapel Hill.

**SMOOTHING MAGIC IN RENEWAL THEORY Ph.D. Thesis**

Robert Neal Rodriguez 1977 139 p

Avail: Univ. Microfilms Order No. 7810500

Detailed expansions for the renewal function H(t) and various of its generalizations are considered. An expression for H(t) involving a finite number of derived distributions is derived for the infinite variance case. In addition, the approach yields refined expansions for the factorial moments and cumulants of the number of renewals in the time interval (0,t). By developing estimates for the moments of the forward recurrence-time, the variance of the number of renewals in an interval of time away from the origin are evaluated. Several theorems are applied in a discussion of the time-dependent behavior of the superposition of identical independent renewal processes. Aspects considered include the distribution of the number of events in a time interval near the origin, as well as the variance-time and covariance-time functions. Dissert. Abstr.

**N78-31835#** Toronto Univ. (Ontario). Inst. for Aerospace Studies.

**NUMERICAL MINIMIZATION METHODS FOR FUNCTIONALS: COMPARISON AND EXTENSIONS Ph.D. Thesis**
S. C. Garg Jul. 1977 353 p refs Sponsored by Natl. Res. Council of Can.
(UTIAS-209; CN-ISSN-0082-5255) Avail: NTIS HC A16/MF A01

A unification and review of numerical minimization methods for functionals on finite and infinite-dimension spaces is presented as well as a generalization of the symmetric rank-one and Davidon's second algorithms and their properties to infinite-dimensional space. A computational comparison and evaluation of selected methods, including a second-order method is included. Numerical methods are given for optimal control problems having functionals depending on fixed parameters and functions of time. Methods examined include: steepest descent, optimum gradient, conjugate gradient, Davidon's variable-metric method, modified quasilinearization with optimum initial choice of multipliers, and two versions of Davidon's rank-one method, extended by the author to the present class of problems. A new second-order gradient method is derived from a functional analysis viewpoint, and a mathematical justification is given for the so-called 'clipping' technique of treating control variable inequality constraints in gradient-based methods. The implementation of these algorithms as computer programs is analyzed with particular attention to the integration of ordinary differential equations. A.R.H.

**N78-31836*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**AN ALTERNATING DIRECTION IMPLICIT METHOD FOR THE CONTROL DATA STAR-100 VECTOR COMPUTER**
Jules J. Lambiotte, Jr. Sep. 1978 25 p refs
(NASA-TP-1282; L-12287) Avail: NTIS HC A02/MF A01 CSCL 12A

An implementation of the alternating direction implicit (ADI) method for the Control Data STAR-100 computer is presented and analyzed. Two parallel algorithms, both of which are most efficient when used to solve many independent tridiagonal systems of equations, are discussed relative to their usefulness in an ADI implementation on the STAR-100 computer. It is shown that it may be desirable to alternate between the parallel algorithms as the direction of implicitness is alternated in order to eliminate the data rearrangement which would otherwise be required. The applicability of the two parallel tridiagonal solvers to several other numerical algorithms is also discussed. Author

**N78-31837#** Arizona Univ., Tucson. Dept. of Mathematics.
**SINGULAR PERTURBATIONS OF SEMILINEAR SECOND ORDER SYSTEMS**
F. A. Howes (Minnesota Univ., Minneapolis) and R. E. OMalley, Jr. May 1978 21 p refs
(Contract N00014-76-C-0326)
(AD-A055279; TR-20) Avail: NTIS HC A02/MF A01 CSCL 12/1

Many physical problems occur as two-point boundary value problems for some systems. Although scalar problems have been quite thoroughly analyzed in the last twenty-five years, vector problems have rarely been examined. Results providing nonuniform convergence to the solution of appropriate reduced problems away from endpoint boundary layers are presented. Possibilities involving interior transition layers will also be considered. GRA

**N78-31838#** Texas Univ. at Austin. Center for Cybernetic Studies.
**DEGENERACY IN SPECIAL PURPOSE PRIMAL ALGORITHMS USED IN OBTAINING LEAST ABSOLUTE VALUE ESTIMATORS**
R. D. Armstrong, A. Charnes, and J. P. Godfrey Nov. 1977 26 p refs
(Contracts N00014-75-C-0616; N00014-75-C-0569; Grant NSF MCS-77-01000)
(AD-A055042; CCS-316) Avail: NTIS HC A03/MF A01 CSCL 12/1

Efficient algorithms have been developed recently which utilize the specialized structure of the linear programming formulation for the problem of least absolute value estimation. These algorithms generally proceed in the direction of steepest descent along an edge of a convex polyhedral surface. However, we will show that the extreme point path of steepest descent may not be taken when degeneracy occurs. We will also present a criterion that determines the basic edge for steepest descent. Author (GRA)

**N78-31839#** California Univ., Los Angeles.
**SCHEME-INDEPENDENT STABILITY CRITERIA FOR DIFFERENCE APPROXIMATIONS OF HYPERBOLIC INITIAL-BOUNDARY VALUE PROBLEMS, 1 Interim Report**
Moshe Goldberg and Eitan Tadmor (Tel-Aviv Univ.) 1978 20 p refs
(Grant AF-AFOSR-3046-76)
(AD-A055022; AFOSR-78-0911TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Easily checkable sufficient stability criteria are obtained for explicit dissipative approximations to mixed initial-boundary value problems associated with the system u sub t = Au sub x in the quarter plane x = or > 0, t = or > 0. The criteria are given entirely in terms of the boundary conditions for the outflow unknowns. The results imply that certain well known boundary conditions, when used in combination with any (stable) dissipative scheme, always maintain stability. Author (GRA)

**N78-31840#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
**DYNAMICS OF A THREE DEGREE OF FREEDOM KINEMATIC CHAIN**
Berthold K. P. Horn, Ken-ichi Hirokawa, and Vijay V. Vazirani Oct. 1977 60 p refs
(Contract N00014-77-C-0389)
(AD-A055612; AI-M-478) Avail: NTIS HC A04/MF A01 CSCL 06/4

In order to be able to design a control system for high-speed control of mechanical manipulators, it is necessary to understand properly their dynamics. An analysis is presented here of a detailed model of a three-link device which may be viewed as either a leg in a locomotory system, or the first three degrees of freedom of an arm providing for its gross motions. The equations of motion are shown to be non-trivial, yet manageable. GRA

**N78-31841#** Texas Technological Univ., Lubbock. Dept. of Electrical Engineering.
**FREQUENCY DOMAIN STABILITY IN SINGLE AND MULTI-DIMENSIONAL SYSTEMS**
R. Saeks, J. Murray, R. A. DeCarlo, K. S. Chao, and E. C. Huang 1978 113 p refs
(Grant AF-AFOSR-2631-74)
(AD-A055393; AFOSR-78-1047TR) Avail: NTIS HC A06/MF A01 CSCL 05/8

This report summarizes research into stability theory for single and multi-dimensional systems using frequency domain techniques. Specific items deal with the Nyquist test for multi-dimensional digital filters, spectral factorization for multi-dimensional digital filters, half-plane filters, an algebraic-topological derivation of the classical Nyquist criterion, and a Continuation Algorithm for implementing the multivariable Nyquist criterion. Author (GRA)

**N78-31842#** Washington Univ., Seattle. Dept. of Mathematics.
**COMBINATORIAL OPTIMIZATION: WHAT IS THE STATE OF THE ART**
Victor Klee May 1978 68 p refs
(Contract N00014-67-A-0103-003; NR Proj. 044-353)
(AD-A055722; TR-63) Avail: NTIS HC A04/MF A01 CSCL 12/1

This survey attempts, without including many details of algorithms or of the underlying theory, to answer the questions of what is combinatorial optimization. GRA

**N78-31843#** California Univ., Livermore. Lawrence Livermore Lab.
**ALGEBRAIC SIMPLIFICATION OF INTERCONNECTED SYSTEMS**
Stephen J. Hegner 31 Mar. 1978 72 p refs
(Contract W-7405-eng-48)
(UCID-17760) Avail: NTIS HC A04/MF A01

The development of strategies for simplification of large-scale

interconnected systems by substituting, in the model, components which are simpler than the original ones is discussed. First, a general framework for discussing interconnection and interconnective modeling is developed, based upon the concepts of universal algebra. Then the simplification of systems which may be described by use of matrices over a semiring is investigated in detail. Examples of such systems include the behaviors of multi-input, multi-output linear systems. ERA

**N78-31844#** Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
**SYMMETRY, AUTOMORPHISM AND TEST**
Claudine Turcat and Andre Verdillon 14 Oct. 1977 18 p refs Submitted for publication
(CEPHAG-46/77) Avail: NTIS HC A02/MF A01

A method is presented to show how using network symmetries (or the graph-theory concept of automorphism) leads to cluster faults into classes and thus simplifies the process of finding a test set: tests for these automorphic classes are found by classical methods and then expanded using automorphisms to produce a test-set. The process does not seem more complex than the classic ones. Furthermore, by using a multi-level description, the process is easily extended to networks of modules.Author (ESA)

**N78-31845#** Royal Aircraft Establishment, Farnborough (England).
**THE DEVELOPMENT OF QUASI-NEWTON METHODS FOR UNCONSTRAINED MINIMISATION**
A. G. Purcell Aug. 1977 68 p refs
(RAE-TR-77132; BR60413) Avail: NTIS HC A04/MF A01

Formulae for updating matrices in connexion with the quasi-Newton iteration are derived so as to emphasize the principles involved. Computational aspects are discussed and two FORTRAN (CM 0402 and M2 1UNC) programs for nonlinear minimization subject to bounds on the variables are described and their use of finite difference derivatives, treatment of bounds, line searches, and post-optimal sensitivity facilities are compared to demonstrate the manner in which the subject has progressed in recent years. Brief user guides to the two programs are contained in appendices. Author (ESA)

# 65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

**N78-31846** Johns Hopkins Univ., Baltimore, Md.
**CONDITIONS FOR STRONG CONSISTENCY OF M-ESTIMATORS FOR LOCATION Ph.D. Thesis**
Forest Claude Deal, Jr. 1978 76 p
Avail: Univ. Microfilms Order No. 7811768

Sufficient conditions and necessary conditions are given for an M-estimator of location to have strong consistency (i.e., to coverge almost surely to its associated parameter). This is done under mild regularity conditions on the rho or psi function defining the M-estimator and for the case where the observations are univariate, independent, and identically distributed according to a distribution which has a unimodal density. A method is given for choosing an estimator in the case that the M-estimator is multivalued. Conditions are also given under which a consistent M-estimator may remain so while being made scale invariant.
Dissert. Abstr.

**N78-31847** Pennsylvania State Univ., University Park.
**A STUDY OF WEIGHTED DISTRIBUTIONS AND SIZE-BIASED SAMPLING Ph.D. Thesis**
Mohamed Mahfoud 1978 103 p
Avail: Univ. Microfilms Order No. 78-12063

The concept of weighted distributions can be extended to accommodate moment distributions known in economics and mass-size distribution used in small particle physics and sedimentology. Examples of weighted distributions and how they arise in a wide range of scientific areas are surveyed. The properties of the weighted distributions are studied in comparison with those of the original distributions. Bivariate weighted distributions with different wf's are studied. The wf $w(x,y) = x$ to the alpha power is considered. Bivariate weighted distributions with wf $w(x,y) = \max(x,y)$ are also studied. Other forms of the wf $w(x,y)$ are considered for specific bivariate distributions, and how their effects on parameters of the original bivariate distributions are given. Dissert. Abstr.

**N78-31848** California Univ., Berkeley.
**MEASURES ON THE INTEGERS AND LIMIT DISTRIBUTIONS OF ADDITIVE, NUMBER-THEORETIC FUNCTIONS Ph.D. Thesis**
Photius Nanopoulos 1977 75 p
Avail: Univ. Microfilms Order No. 78-12711

Analogous results using the zeta distributions are given. One main property of these measures is an independence property, namely in factorization of integers as products of powers of prime numbers; the exponents of the different primes are independent random variables. All measures having the independence property in terms of the weights they assign to progression sets are characterized. The two particular cases (frequency and zeta distributions) are examples of families of measures which converge in a weak sense to a translation invariant finitely additive probability measure on the integers. Necessary and sufficient conditions are given for the convergence of the distributions of additive number-theoretic functions. This is done for the general case of infinitely divisible limits. In addition it is shown that Gaussian limits can occur only for infinitesimal arrays.
Dissert. Abstr.

**N78-31849** Illinois Inst. of Tech., Chicago.
**A WAY TO REMOVE THE BIAS OF THE CHI-SQUARE TEST Ph.D. Thesis**
John Paris 1977 95 p
Avail: Univ. Microfilms Order No. 78-11820

The chi-square goodness-of-fit test was investigated. A new statistic which employs M.L.E.'s from the original observations is derived and has in the limit an exact analytic distribution. Computer programs were written for testing goodness-of-fit to a normal distribution. Furthermore, the necessary analysis for testing the Poisson, exponential and binomial distribution is also included. Dissert. Abstr.

**N78-31850** Temple Univ., Philadelphia, Pa.
**KOLMOGOROV-SMIRNOV TEST STATISTICS FOR THE GAMMA DISTRIBUTION WITH UNKNOWN PARAMETERS Ph.D. Thesis**
Bruce Edward Schneider 1978 152 p
Avail: Univ. Microfilms Order No. 78-12238

The Kolmogorov-Smirnov goodness-of-fit test for the gamma distribution with unknown parameters was investigated. The two-parameter (scale and shape) model is assumed and the cases of either or both parameters unknown are considered using maximum likelihood estimators. The practical considerations involved with the use of such tests are discussed and a testing procedure is outlined. These discussions are supplemented by examples of the use of the procedure as applied to seven different data sets. To examine the small sample performance of the Kolmogorov-Smirnov test statistic under various alternatives and compare it with other test statistics, a Monte Carlo power study is presented assuming the 0.05 significance level for samples of size 10 and 20. Attention is focused on four other EDF statistics (the Kuiper, Cramer-von Mises, Watson, and Anderson-Darling types), the chi-square statistic, and a rank test due to Locke. The null distributions of the other four EDF statistics are also obtained by Monte Carlo distributions. Dissert. Abstr.

**N78-31851** Purdue Univ., Lafayette, Ind.
**POWER COMPARISONS OF TWO-SIDED TESTS OF EQUALITY OF TWO COVARIANCE MATRICES AND SOME DISTRIBUTION THEORY Ph.D. Thesis**
Shih-fu Sylvia Shen 1977 175 p
Avail: Univ. Microfilms Order No. 78-13120

A thesis is presented which deals with the following: (1) power studies of covariance matrices of two p-variate normal populations against two-sided alternatives based on six criteria - Roy's largest root, Hotelling's trace, Pillai's trace, Wilks' criterion, Roy's largest and smallest roots, and modified likelihood ratio (in the real case); (2) based on the first five criteria; (3) some monotonicity properties in the complex case for MANOVA and

cononical correlation; (4) the distribution of Wilks' criterion through variable transformation; and (5) the noncentral distribution of the characteristics roots of the Wishart matrix under an assumption and the sphericity criterion under violation. Some theorems are proven and certain problems are suggested for further research. Dissert. Abstr.

**N78-31852** Pennsylvania State Univ., University Park.
**A ROBUST CLASS OF TESTS AND ESTIMATES FOR MULTIVARIATE LOCATION BASED ON RANKS Ph.D. Thesis**
Jessica Marie Utts 1978 100 p
Avail: Univ. Microfilms Order No. 78-12084

A class of tests and estimates for the center of a symmetric p-variate distribution are introduced and several of its properties are examined. The tests and estimates are derived from a vector of scored rank statistics h, where the scores equal the ranks for the first n(1-v) ranks and a constant thereafter. Estimates can be computed directly, but a less time-consuming scheme based on an iterative combination of weighted least squares and interval halving are proposed. Procedures to replace Hotelling's T square and the companion vector of samples means are developed. Dissert. Abstr.

**N78-31853** Washington Univ., Seattle.
**SMALL SAMPLE ROBUSTNESS PROPERTIES OF GENERALIZED M-ESTIMATORS APPLIED TO FIRST ORDER AUTOREGRESSION Ph.D. Thesis**
Jeffrey Brian Birch 1978 233 p
Avail: Univ. Microfilms Order No. 78-14407

The classical first order autoregressive model, AR(1), is adjusted to reflect two types of outliers. The first outlier model is the innovations model where the process innovations follow a variety of heavy-tailed, symmetric distributions. The second outlier model is the additive effect model where the innovations follow the standard Gaussian distribution but the values actually observed are equal to the process value plus noise or an additive effect. The additive effects are equal to zero with high probability but occasionally, with probability, follow a heavy-tailed, symmetric distribution. The classical least squares estimate is evaluated in terms of its robustness properties as a point estimator and as a confidence interval estimate over the proposed outlier models at small samples via Monte Carlo techniques. Also evaluated in terms of their small sample robustness properties are seven point estimates and their confidence interval estimates. Dissert. Abstr.

**N78-31854*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**SIMULATION STUDY OF THE POWER OF THE KOLMOGOROFF-SMIRNOFF AND Z TESTS FOR THE EXPONENTIAL DISTRIBUTION**
John B. Gayle Sep. 1978 18 p refs
(NASA-TP-1311) Avail: NTIS HC A02/MF A01 CSCL 12A

Simulation tests were carried out to compare the power of the Kolmogoroff-Smirnoff and Z tests for the exponential distribution against a wide range of alternative distributions. The results indicate that both tests should be used for applications for which detailed knowledge regarding the possible classes of alternative distributions is lacking. Author

**N78-31855#** Florida State Univ., Tallahassee. Dept. of Statistics.
**TESTING TO DETERMINE THE UNDERLYING DISTRIBUTION USING RANDOMLY CENSORED DATA Interim Report**
Myles Hollander and Frank Proschan Apr. 1978 24 p refs
(Grant AF-AFOSR-3109-76; AF Proj. 2304)
(AD-A054978; FSU-STATISTICS-M458; TR-6-AFOSR; AFOSR-78-0939TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

For right-censored data, a goodness-of-fit procedure is developed for testing whether the underlying distribution is a specified functions G. The test statistic C is the one-sample limit of Efron's (1967) two-sample statistic W. The test based on C is compared with recently proposed competitors due to Koziol and Green (1976) and Hyde (1977). The comparisons are on the basis of applicability, the extent to which the censoring distribution can affect the inference, and power. It is shown that in certain situations the C test compares favourably with the tests of Koziol-Green and Hyde. GRA

**N78-31856#** Army Concepts Analysis Agency, Bethesda, Md.
**A COMPUTER PROGRAM FOR FITTING CENSORED SAMPLES TO A WEIBULL DISTRIBUTION (CENWEIB)**
Jerry Thomas and John Gallo Apr. 1978 63 p refs
(AD-A054833; CAA-D-78-5) Avail: NTIS HC A04/MF A01 CSCL 09/2

The Censored Weibull Program (CENWEIB) is a UNIVAC 1108 computer program for fitting censored samples to a Weibull distribution or for generating random data from a Weibull distribution. Maximum likelihood estimating equations are used to calculate parameters for the two-parameter Weibull distribution. Moment estimating equations are used to calculate parameters for the three-parameter Weibull distribution. Author (GRA)

**N78-31857#** North Carolina Univ. at Chapel Hill. Dept. of Statistics.
**SOME PATH PROPERTIES OF p-TH ORDER AND SYMMETRIC STABLE PROCESSES Interim Report**
Stamatis Cambanis May 1978 24 p refs
(Grant AF-AFOSR-2796-76)
(AD-A055844; AFOSR-78-1111TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Necessary and sufficient conditions are presented for the measurability of p-th order or symmetric stable stochastic processes and for the integrability or absolute continuity of sample paths of symmetric stable processes. A sub-Gaussian process has one of these three properties if and only if the corresponding Gaussian process has the same property. Also obtained are sufficient conditions for absolute continuity of p-th order processes. Author (GRA)

**N78-31858#** Rochester Univ., N. Y. Dept. of Statistics.
**MANOVA MULTIPLE COMPARISONS ASSOCIATED WITH FINITE INTERSECTION TESTS**
Govind S. Mudholkar and Perla Subbaiah (Oakland Univ.) 1978 22 p refs
(Grant AF-AFOSR-3360-77)
(AD-A055842; AFOSR-78-1113TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A finite intersection procedure consists of simultaneous tests based upon the variatewise finite decomposition of the MANOVA hypothesis (as in the step-down tests), which is also contrastwise finite. This procedure is stepwise in nature and involves, at each stage, univariate contrastwise finite tests. In this paper the associated method for the multiple comparisons of the means is developed and illustrated. GRA

**N78-31859#** Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
**VARIABLE METRIC METHODS AND FILTERING THEORY Interim Report**
Sanjoy K. Mitter and Pal Toldalagi Jun. 1978 9 p refs
(Grant AF-AFOSR-3281-77)
(AD-A055828; ESL-P-826; AFOSR-78-1102TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

In this paper we show that there is a close relationship between variable metric methods of function minimization and filtering of linear stochastic systems with disturbances which are modelled as unknown but bounded functions. We develop new variable metric algorithms for function minimization. Author (GRA)

**N78-31860#** Tennessee Univ., Knoxville. Dept. of Psychology.
**ESTIMATION OF THE OPERATING CHARACTERISTICS OF THE TWO-PARAMETER BETA METHOD**
Fumiko Samejima May 1978 135 p refs
(Contract N00014-77-C-0360; RR0420401)
(AD-A055611; RR-78-1) Avail: NTIS HC A07/MF A01 CSCL 12/1

The Two-Parameter Beta Method, introduced in the previous study as a method of estimating the operating characteristics of a test item, has proved to be as efficient as the Normal Approximation Method, for a set of simulated data of 500

hypothetical examinees having a uniform latent trait distribution between -2.475 and 2.475. Both methods are characterized: (1) by the use of a relatively small number of subjects-like 500 -- in the whole procedure of estimation; (2) without assuming any prior mathematical model; and (3) by the use of the estimated joint distribution of the latent trait and its maximum likelihood estimate. In the Two-Parameter Beta Method, the method of moments is adopted to approximate the probability density function of the maximum likelihood estimate, using polynomials of degree 3 and 4. The first two conditional moments of the latent trait, given the maximum likelihood estimate, are derived from theory and computed for the data for each value of the maximum likelihood estimate. The conditional distribution of the latent trait, given the maximum likelihood estimate, is approximated by a Beta distribution using the method of moments, with two a priori set parameters and two estimated parameters from the conditional moments. GRA

**N78-31861#** Department of Labor, Washington, D.C. Office of Research and Evaluation.
**BIAS IN THE ESTIMATES OF TREATMENT EFFECTS IN QUASI-EXPERIMENTAL EVALUATIONS**
Aug. 1977 20 p refs
(PB-280060/5; ASPER/INH/T-77/0053/A) Avail: NTIS HC A02/MF A01 CSCL 12A

Nonrandom selection procedures lead to bias in estimates of treatment effects and the direction that such bias takes are examined. The presence of measurement error for the independent variable estimates of treatment effects may be biased is demonstrated. Both the magnitude and direction of the bias are functions of the selection procedures used and the relationship between the variables used in selection and statistical control. The dangers of getting biased estimates of treatment effect are likely to be present in quasi-experimental evaluations of educational and employment programs is discussed. A better strategy is to plan the evaluation strategy at a program's inception so that the likelihood of getting biased estimates of the treatment effect may be minimized. GRA

# 66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

No abstracts in this category.

# 67 THEORETICAL MATHEMATICS

Includes topology and number theory.

**N78-31862** California Univ., Berkeley.
**STABILITY AND MULTICRITERIA OPTIMIZATION Ph.D. Thesis**
Pierre Henry Naccache 1977 99 p
Avail: Univ. Microfilms Order No. 78012709

The behavior of the set-valued map is studied, which sends the data of a multicriteria optimization problem (i.e., feasible decision sets, criterion function, ordering cone) into the set N of nondominated decisions. The geometric structure of such problems is used to obtain sufficient conditons for uppersemicontinuity and lower semicontinuity in linear and nonlinear situations. Several related questions are also examined: e.g., necessary and/or sufficient conditions for N to be nonempty, stability of certain cone-valued maps, and connectedness of the set of nondominated outcomes. Dissert. Abstr.

**N78-31863#** Texas Univ. at Austin. Center for Cybernetic Studies.
**THE SIMPLEX SON ALGORITHM FOR LP/EMBEDDED NETWORK PROBLEMS**
Fred Glover (Colorado Univ., Boulder) and Darwin Klingman Dec. 1977 44 p refs
(Contract N00014-75-C-0616; N00014-75-C-0569; FEA-CR-03-70128-00; NR Proj. 047-021; NR Proj. 047-172) (AD-A055156; CCS-317) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper develops a special partitioning method for solving LP problems with imbedded network structure. These problems include many of the large-scale LP problems of practical importance, particularly in the fields of energy, scheduling and distribution. The special partitioning method, called the simplex special ordered network (SON) procedure, applies to LP problems that contain both non-network rows and non-network columns, with no restriction on the form of the rows and columns that do not exhibit a network structure. These LP/embedded network problems include as a special case multi-commodity network problems and constrained network problems previously treated in the literature, by simultaneously encompassing both side constraints and side activities. GRA

**N78-31864#** Texas Technological Univ., Lubbock. Inst. for Electronics Science.
**BASIC OPTIMAL ESTIMATION AND CONTROL PROBLEMS IN HILBERT SPACE Interim Report**
R. M. DeSantis (Montreal Univ.), R. Saeks, and L. J. Tung (Texas Univ. at El Paso) 1978 76 p refs
(Grant AF-AFOSR-2631-74; AF Proj. 2304)
(AD-A055614; AFOSR-78-1046TR) Avail: NTIS HC A05/MF A01 CSCL 12/1

The recently developed mathematical framework of Hilbert resolution space valued random processes is used to formulate and solve an abstract quadratic optimization problem. By particularizing the description of the operators appearing in the statement and solution formula of this problem one rediscovers and generalizes most of the classical estimation and control theory problem statements and results. These results include, among others, the Wiener smoothing prediction filter, the Kalman regulator, the Kalman-Bucy filter, the stochastic control separation principle and the more recent Youla-Jabr-Bongiorno optimal servo problem solution. Author (GRA)

**N78-31865#** Texas Technological Univ., Lubbock. Inst. for Electronics Science.
**RESOLUTION SPACE, NETWORKS, AND NON-SELF-ADJOINT SPECTRAL THEORY II Interim Report**
R. Saeks, L. J. Tung, R. A. DeCarlo, M. Strauss, and R. M. DeSantis 1978 139 p refs
(Grant AF-AFOSR-2631-74; AF Proj. 2304)
(AD-A055613; AFOSR-78-1045TR) Avail: NTIS HC A07/MF A01 CSCL 12/1

This report summarizes research done in which the theory of operators defined on a Hilbert resolution space is applied to problems arising in system theory. Specific topics include Wiener-Hopf filtering, generalizations of the Nyquist stability criterion to nonlinear and time-varying systems, and a formulation of the theory of systems subjected to relativistic effects. Author (GRA)

# 70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

**N78-31866** Syracuse Univ., N. Y.
**INTEGRAL FORMULATION OF EINSTEIN'S EQUATIONS AND MACH'S PRINCIPLE Ph.D. Thesis**
Ian Athol Nitschke 1977 98 p
Avail: Univ. Microfilms Order No. 78-13325

A gauge independent operator was derived and used in a study of an approach to Mach's principle in which the differential equations of Einstein are reformulated as integral equations such that the effect of distant matter on a local neighborhood in spacetime can be studied, and known spacetime metrics can be categorized as metrics that are completely matter generated (Machian) or metrics that have a matter-free component (non-Machian). It is shown that open expanding Friedmann spacetimes do have the required Machian characteristics, while empty and Schwarzchild-type spacetimes do not satisfy the criteria.

Close Friedmann spacetimes and contracting open Friedmann spacetimes are shown to be non-Machian. Dissert. Abstr.

**N78-31867** North Carolina Univ., Raleigh.
**DEVELOPMENT OF A SET OF GENERAL RIGID AND FLEXIBLE BODY EQUATIONS OF MOTION IN COUPLED FORM USING THE DIRECT APPROACH Ph.D. Thesis**
Nathan Dee Watson 1977 144 p
Avail: Univ. Microfilms Order No. 78-11609

A general set of mathematical equations was developed which predict the time history of both rigid and flexible body motions under the influence of an arbitrary system of forces and moments and to program them for a numerical solution on a high speed digital computer. General expressions for the kinetic and potential energy of a structure which account for large rigid body motions and small linear flexible body motions were derived in matrix form. Lagrange's equations were used to derive the general equations of motion. The principle of virtual work was used to derive generalized force terms. These equations were programmed for a numerical solution on the CDC 6600 computer. Dissert. Abstr.

**N78-31868#** Illinois Univ., Urbana.
**ELECTROMAGNETIC PENETRATION DEPTH IN SUPERCONDUCTING ALLOYS CONTAINING MAGNETIC IMPURITIES Ph.D. Thesis**
J. W. Thomasson 1977 223 p refs
(Contract EY-76-C-02-1198)
(COO-1198-1193) Avail: NTIS HC A10/MF A01

The attenuation of an axial magnetic field by cylindrical, thin, superconducting films were a SQUID-based magnetometer. The sample films, between, 40 and 85 A thick, were composed of indium and of indium containing a small amount of gadolinium. Correction terms were calculated numericallly to transform the attenuation measurements for the finite-length sample into equivalent values for a hypothetical, infinitely long sample which has the sample film evaporated all the way around the substrate. The electromagnetic penetration depth lambda, the reduced penetration depth and the London penetration depth were determined from the corresponding magnetic field attenuation of the infinitely long sample, the film thickness, and other parameters. The results were compared with calculations based on Shilba's theory in the Abrikosov-Gorkov limit. ERA

# 71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

**N78-31869** Pennsylvania State Univ., University Park.
**DIFFRACTION EFFECTS OF BAFFLES ON ACOUSTIC DIRECTIVITY PATTERNS Ph.D. Thesis**
William Jack Hughes 1978 172 p
Avail: Univ. Microfilms Order No. 78-12052

The acoustic diffraction phenomena which occur at the edges of a baffle were investigated both experimentally and theoretically. Various sharp-edged and cylindrical-edged baffles were constructed in which geometry, impedance, and structural resonances were controlled. Data were obtained as a function of incident pressure, angle of incidence, and frequency, using two transducers, one in the far field and one on the baffle surface. Also investigated was the effect of placing small scattering barriers at the edge of rigid baffle surfaces. The geometrical theory of diffraction was used to develop a theoretical model for the calculation of patterns. Patterns obtained with rigid baffle surfaces exhibited ripples in the insonified region while soft baffles gave rise to a smooth bell-shaped directivity pattern with highly attenuated diffraction fields. The good agreement obtained between theory and experiment confirms the validity of the geometrical theory of diffraction. Dissert. Abstr.

**N78-31870** Pennsylvania State Univ., University Park.
**AN ACOUSTIC FIELD GENERATED BY SUBSONIC JETS AT LOW REYNOLDS NUMBERS Ph.D. Thesis**
Kingo Yamamoto 1978 216 p
Avail: Univ. Microfilms Order No. 78-12091

Extensive flow and acoustic measurements in low Reynolds number turbulent jets were undertaken using miniature nozzles of the same configuration but different diameters at various exit Mach numbers. The results of circumferential cross-correlation measurements in the far field show that only the axisymmetric and the first helical modes have any practical importance in jet noise for Strouhal numbers between 0.1 and 1.0. It was also established that azimuthal mode has a corresponding dominant emission angle. Coherency of jet noise was observed over a rather broad range of frequency at emission angle close to the jet axis. A careful study of narrow-band spectrum of the radiated sound revealed the existence of a critical Reynolds number associated with the peak frequency of jet noise. Dissert. Abstr.

**N78-31871*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**CORRELATION OF COMBUSTOR ACOUSTIC POWER LEVELS INFERRED FROM INTERNAL FLUCTUATING PRESSURE MEASUREMENTS**
U. H. VonGlahn 1978 26 p refs Proposed for presentation at the 96th Meeting of the Acoust. Soc. of Am., Honolulu, Hawaii, 26 Nov. - 1 Dec. 1978
(NASA-TM-78986; E-9764) Avail: NTIS HC A03/MF A01 CSCL 20A

Combustion chamber acoustic power levels inferred from internal fluctuating pressure measurements are correlated with operating conditions and chamber geometries over a wide range. The variables include considerations of chamber design (can, annular, and reverse-flow annular) and size, number of fuel nozzles, burner staging and fuel split, airflow and heat release rates, and chamber inlet pressure and temperature levels. The correlated data include those obtained with combustion component development rigs as well as engines. Author

**N78-31872*#** Missouri Univ. -Rolla. Dept. of Mechanical and Aerospace Engineering.
**A STUDY OF THE STRUCTURAL-ACOUSTIC RESPONSE AND INTERIOR NOISE LEVELS OF FUSELAGE STRUCTURES Final Report, Sep. 1974 - Aug. 1978**
Leslie R. Koval Sep. 1978 16 p refs
(Grant NsG-1050)
(NASA-CR-157589) Avail: NTIS HC A02/MF A01 CSCL 20A

Models of both flat and curved fuselage panels were tested for their sound transmission characteristics. The effect of external air flow on transmission loss was simulated in a subsonic wind-tunnel. By numerically evaluating the known equations for field-incidence transmission loss of single-walled panels in a computer program, a comparison of the theory with the test results was made. As a further extension to aircraft fuselage simulation, equations for the field-incidence transmission loss of a double-walled panel were derived. Flow is shown to provide a small increase in transmission loss for a flat panel. Curvature is shown to increase transmission loss for low frequencies, while also providing a sharp decrease in transmission loss at the ring frequency of the cylindrical panel. The field-incidence transmission loss of a double-walled panel was found to be approximately twice that for a single-walled panel, with the addition of dips in the transmission loss at the air gap resonances and at the critical frequency of the internal panel. Author

**N78-31873*#** Kansas Univ., Lawrence. Center for Research, Inc.
**A RESEARCH PROGRAM TO REDUCE INTERIOR NOISE IN GENERAL AVIATION AIRPLANES: NOISE REDUCTION THROUGH A CAVITY-BACKED FLEXIBLE PLATE**
Jan Roskam and Cornelis P. G. vanDam Aug. 1978 103 p refs
(Grant NsG-1301)
(NASA-CR-157588; KU-FRL-317-8) Avail: NTIS HC A06/MF A01 CSCL 20A

A prediction method is reported for noise reduction through a cavity-backed panel. The analysis takes into account only cavity modes in one direction. The results of this analysis were to find the effect of acoustic stiffness of a backing cavity on the panel behavior. The resulting changes in the noise reduction through the panel are significant. G.G.

**N78-31874*#** Kansas Univ. Center for Research, Inc., Lawrence. Center for Research, Inc.

**A RESEARCH PROGRAM TO REDUCE INTERIOR NOISE IN GENERAL AVIATION AIRPLANES: INVESTIGATION OF THE CHARACTERISTICS OF AN ACOUSTIC PANEL TEST FACILITY**

Ferd Grosveld and Jan vanAken Sep. 1978 151 p refs (Grant NsG-1301)

(NASA-CR-157587; KU-FRL-317-9) Avail: NTIS HC A08/MF A01 CSCL 20A

Sound pressure levels in the test facility were studied that are caused by varying: (1) microphone positions; (2) equalizer setting; and (3) panel clamping forces. Measurements were done by using a Beranek tube or this Beranek tube in combinations with an extension tube and a special test section. In all configurations tests were executed with and without a test panel installed. The influence of the speaker back panel and the back panel of the Beranek tube on the sound pressure levels inside the test tube were also investigated. It is shown that the definition of noise reduction is more useful in relation to this test facility than transmission loss. G.G.

**N78-31875#** Toronto Univ. (Ontario). Inst. for Aerospace Studies.

**THE INFLUENCE OF BACKGROUND NOISE LEVEL AND SIGNAL DURATION ON THE JUDGED ANNOYANCE OF AIRCRAFT NOISE**

G. W. Johnston and A. A. Haasz Aug. 1978 33 p refs (UTIAS-228; CN-ISSN-0082-5255) Avail: NTIS HC A03/MF A01

A series of 72 flyover events were assessed by a jury of 35 observers, during 12 separate listening sessions conducted in a controlled test area designed to simulate typical indoor listening conditions. Each aircraft signal was superimposed on a controlled random traffic background signal having a duration exceeding that of the aircraft event. The presence of a steady mean traffic background noise can reduce the perceived noisiness of aircraft flyover events, provided that the judgment time available is sufficiently greater than the event time (time in excess of background). For a given peak event level, a reduction in associated background noise of 21 dBA is shown to be equivalent subjectively to an increase of 5.5 dBA in peak event level, with fixed background conditions. Although regressions obtained with the noise pollution index, L sub NP, for single event judgments generally showed a lower correlation than the L sub o and L sub p - L sub o regression variables, the score data did show a number of significant trends which are also associated with the LNP index variations computed for single noise events. A.R.H.

**N78-31876*#** Texas Univ. at Austin. Applied Res. Labs.

**EXPERIMENTAL INVESTIGATION OF OUTDOOR PROPAGATION OF FINITE-AMPLITUDE NOISE Final Report**

Don A. Webster and David T. Blackstock Aug. 1978 141 p refs

(Contract NAS1-14160)

(NASA-CR-2992; ARL-TR-78-31) Avail: NTIS HC A07/MF A01 CSCL 20A

The outdoor propagation of finite amplitude acoustic waves was investigated using a conventional electroacoustic transmitter which was mounted on the ground and pointed upward in order to avoid ground reflection effects. The propagation path was parallel to a radio tower 85 m tall, whose elevator carried the receiving microphone. The observations and conclusions are as follows: (1) At the higher source levels nonlinear propagation distortion caused a strong generation of high frequency noise over the propagation path. For example, at 70 m for a frequency 2-3 octaves above the source noise band, the measured noise was up to 30 dB higher than the linear theory prediction. (2) The generation occurred in both the nearfield and the farfield of the transmitter. (3) At no measurement point was small-signal behavior established for the high requency noise. Calculations support the contention that the nonlinearity generated high frequency noise never becomes small-signal in its behavior, regardless of distance. (4) When measured spectra are scaled in frequency and level to make them comparable with spectra of actual jet noise, they are found to be well within the jet noise range. It is therefore entirely possible that nonlinear distortion affects jet noise. A.R.H.

**N78-31877#** Royal Aircraft Establishment, Farnborough (England).

**A METHOD FOR THE EXACT DETERMINATION OF NOISE PARAMETERS OF ACTIVE TWOPORTS IN THE FREQUENCY RANGE 1 GHz TO 11 GHz**

Christos Tsironis Mar. 1978 17 p refs Transl. into ENGLISH from Nachrichtentech. Z. (West Germany), no. 5, 1976 p 385-389

(RAE-Lib-Trans-1963; BR63701) Avail: NTIS HC A02/MF A01

A simplified measuring procedure using a computer is demonstrated that allows the determination of the four noise parameters of linear active twoports at microwave frequencies. The usual on-off noise measurement procedures in the GHz range (Y-factor method) were modified so that the change in generator impedance between the on and off states does not influence the final result. Additionally, the proposed method does not need any determination of the receiver stage noise properties. Some noise parameters of 1.5 micron - gate MeSFETs are given in the frequency range 2 GHz to 10 GHz as an example. Author

**N78-31878#** Army Construction Engineering Research Lab., Champaign, Ill.

**HYPOTHETICAL CASE STUDIES OF OPERATIONAL CHANGES TO REDUCE NOISE LEVELS Interim Report**

Richard J. Goff and Violetta I. Pawlowska May 1978 41 p (DA Proj. 4A7-6270-A-896)

(AD-A055066; CERL-IR-N-44) Avail: NTIS HC A03/MF A01 CSCL 19/4

This report describes the effectiveness of various noise mitigation techniques as applied to blast noise, the Army's most significant noise source. The main thrust of the analysis was aimed at operational changes, including relocation, rescheduling, and firing during more optimal weather conditions. Three hypothetical case studies were investigated, and each technique was quantitatively evaluated. It was found that the three types of operational changes studied did prove more or less effective. However, these mitigation techniques are site-specific, and the decision to use them should be based on how they will affect the base mission, their cost-effectiveness, their noise reduction abilities in terms of decibels, and their benefits to the individual site. Author (GRA)

**N78-31879#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Inst. fuer Turbulenzforschung.

**NOISE GENERATION AND NOISE PROPAGATION IN CENTRIFUGAL FANS [SCHALLERZEUGUNG UND SCHALLAUSBREITUNG IN RADIALVENTILATOREN]**

M. Bartenwerfer and T. Gikadi (Tech. Univ. Berlin) 1978 41 p refs In GERMAN

(DLR-IB-257-78/1) Avail: NTIS HC A03/MF A01

Velocity oscillations at the impeller exit of centrifugal fans were investigated in order to explain the relationship between flow condition and the aerodynamic noise. Two procedures, based on linear equation systems, for the calculation of the frequency distribution of the system are discussed. It was found that the Reynolds number has no appreciable influence on the noise generation. ESA

**N78-31304#** Compagnie Generale de Telegraphie sans Fil, Paris (France). Div. des Activities Sous-Marines Chemin des Travails.

**READING AND ACOUSTIC PROCESSING OF OPTICAL IMAGES [LECTURE ET TRAITEMENT ACOUSTIQUES D'IMAGES OPTIQUES]**

H. Gautier, C. Maerfeld, and P. Tournois *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 11 p refs In FRENCH (For primary document see N78-31279 22-31)

Avail: NTIS HC A21/MF A01

# 72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

**N78-31880#** National Bureau of Standards, Boulder, Colo. Time and Frequency Div.
**SUMMARY OF WORK ON COOLED ION FREQUENCY STANDARD Annual Report, Aug. - Dec. 1977**
D. J. Wineland and F. L. Walls 5 May 1978 5 p refs
(Contract N00014-77-F-0046; RR0110301)
(AD-A054234) Avail: NTIS HC A02/MF A01 CSCL 07/4

The purpose of this work is to develop techniques to overcome the fundamental limits of present frequency standards--the second and residual first-order Doppler shifts. To this end suitable frequency reference transitions are studied in ions which are stored in electromagnetic traps and cooled by radiation pressure to - 1K. GRA

**N78-31881#** Air Force Academy, Colo. Frank J. Seiler Research Lab.
**MOLECULAR ORBITAL CALCULATIONS ON MOLECULES OF AIR FORCE INTEREST**
Larry P. Davis and Guidry R. Martin May 1978 33 p refs
(AF Proj. 2303)
(AD-A055072; FJSRL-TR-78-0002) Avail: NTIS HC A03/MF A01 CSCL 20/10

Quantum mechanical problems of Air Force interest have been studied using available semiempirical molecular orbital programs. Results for NF potential curves were not satisfactory. Studies of molecules involved in TNT thermochemical decomposition, organic electrochemistry, and rocket plumes have yielded promising results. Author (GRA)

**N78-31882#** California Univ., Berkeley. Lawrence Berkeley Lab.
**PIONIC INSTABILITIES IN HIGH-ENERGY HEAVY ION COLLISIONS**
Miklos Gyulassy Jun. 1977 22 p refs Proceedings of Macroscopic Properties of Heavy Ion Collision, Pikeville, Tenn., 12 Jun. 1977
(Contract W-7405-eng-48)
(LBL-6525; Conf-770602-3) Avail: NTIS HC A02/MF A01

Heavy ion reactions were studied. The determination of whether pionic instabilities can exist at the densities and excitation energies expected in heavy ion collisions, the calculation of growth rates of unstable pion modes, and the determination of the effect such instabilities would have on the dynamics in heavy ion collisions were included. ERA

**N78-31883#** Sandia Labs., Albuquerque, N. Mex.
**REB FOCUSING IN A HIGH-VOLTAGE DIODE**
I. P. Afonin, M. V. Babykin, B. V. Baev, K. A. Baigarin, A. V. Bartov, B. A. Demidov, S. D. Fanchenko, P. P. Gavrin, M. V. Ivkin, and E. D. Korop Feb. 1978 25 p refs Transl. into ENGLISH of "Issledovanie Fokusirovki REP v Vysokovoltnom diode", Kurchatov Inst. of Atomic Energy, Moscow
(SAND-78-6005) Avail: NTIS HC A02/MF A01

Experimental data on the focusing of an intense relativistic electron beam on the Angara-1 and Kalmar-1 pulsed electron accelerators are reported. The use of these accelerators to simulate conditions in a controlled thermonuclear reactor with inertial plasma confinement is discussed. ERA

**N78-31884#** Yale Univ., New Haven, Conn.
**EXPERIMENTAL STUDIES OF ELECTRON IMPACT DEPOPULATION OF EXCITED STATES OF ATOMS: APPLICATION TO LASER DEVELOPMENT FOR FUSION AND ISOTOPE SEPARATION Progress Report, 1 Jan. - 31 Dec. 1977**
M. S. Lubell 1 Mar. 1977 12 p refs
(Contract ES-77-S-02-4199)
(COO-4199-1) Avail: NTIS HC A02/MF A01

Rare gas and rare gas halide excimers are attractive candidates for use in efficient high power lasers because the ground state has either a repulsive character or at worst only a very shallow well. Once stimulated emission from the attractive excited state occurs, the excimer dissociates precluding saturation effects due to radiation trapping. The most efficient procedure for excitation is generally recognized to be e-beam or e-beam controlled discharge pumping. The depopulation of the metastable states of rare gas atoms by electron impact is examined. Superelastic, inelastic, and ionization process are studied using a crossed electron-atom beam configuration. ERA

**N78-31885#** California Univ., Berkeley. Lawrence Berkeley Lab.
**VIBRATIONAL RELAXATION AND ENERGY TRANSFER OF MATRIX ISOLATED HCl AND DCl Ph.D. Thesis**
Jay Martin Wiesenfeld Dec. 1977 386 p refs
(Contract W-7405-eng-48)
(LBL-7344) Avail: NTIS HC A17/MF A01

Vibrational kinetic and spectroscopic studies were performed on matrix-isolated HC1 and DC1 between 9 and 20 K. Vibrational relaxation rates for v=2 and v=1 were measured by a tunable infrared laser-induced, time-resolved flourescence technique. In an Ar matrix, vibrational decay times are faster than radiative and it is found that HC1 relaxes about 35 times more rapidly than CC1, in spite of the fact that HC1 must transfer more energy to the lattice than DC1. Molecular complexes, and in particular the HC1 dimer, relax too rapidly for direct observation, less than or approximately 1 mu s, and act as energy sinks in the energy diffusion process. Vibrational relaxation of HC1 in N2 and O2 matrices is unobservable, presumably due to rapid V yield V transfer to the host. A V yield R binary collision model for relaxation in solids considers relaxation to be the result of collisions due to molecular motion in quantized lattice normal modes; gas phase potential parameters can fit the matrix kinetic data. ERA

**N78-31886#** Tennessee Valley Authority, Chattanooga. Div. of Environmental Planning.
**LEAST-SQUARES RESOLUTION OF GAMMA-RAY SPECTRA IN ENVIRONMENTAL SAMPLES**
Larry G. Kanipe, Stephen K. Seale, and Walter S. Liggett Aug. 1977 184 p
(PB-280237/9; TVA-EP/78-02; EPA-600/7-77-089) Avail: NTIS HC A09/MF A01 CSCL 18H

The use of ALPHA-M, a least squares computer program for analyzing NaI (Tl) gamma spectra of environmental samples, is evaluated. Included is a comprehensive set of program instructions, listings, and flowcharts. Two other programs, GEN4 and SIMSPEC, are also described. GEN4 is used to create standard libraries for ALPHA-M, and SIMSPEC is used to simulate spectra for ALPHA-M analysis. Tests to evaluate the standard libraries selected for use in analyzing environmental samples are provided. An evaluation of the results of sample analyses is discussed. GRA

**N78-32002*#** California Univ., Berkeley. Lawrence Berkeley Lab.
**RADIATION DAMAGE OF GERMANIUM DETECTORS**
Richard H. Pehl *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 473-478 refs (For primary document see N78-31971 22-88)
(Contract W-7405-eng-48)
Avail: NTIS HC A25/MF A01 CSCL 20K

# 73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

**N78-31887** California Univ., Riverside.
**A SEARCH FOR CHARMED MESON PRODUCTION IN PROTON-PROTON COLLISIONS AT THE CERN-ISR Ph.D. Thesis**
Gordon John Vandalen 1978 214 p
Avail: Univ. Microfilms Order No. 7814074

Two magnetic spectrometers located at -32 deg and 44 deg from beam 2 of intersection I6 of the CERN intersecting storage

rings (ISR) were used to look at the invariant mass distributions of two charged hadrons (pi, K or p). Experimental results on a search for D (1865) mesons produced at y approximately 1.0 in proton-proton collisions at the center of mass energy of 53 GeV are presented here. Cross section upper limits of 8 barns and 9 barns at the 95% confidence level were measured for the processes (p plus p yields neutral D plus X, neutral D yields negative K plus positive pi) and (p plus p yields the antiparticle neutral D plus X, antiparticle neutral D yields positive K and negative pi) respectively. The production of neutral f (1270), neutral g (1680), and neutral * K (1420) were also observed.
Dissert.Abstr.

**N78-31888** Virginia Polytechnic Inst. and State Univ., Blacksburg.
**FUNCTIONAL ANALYTIC TREATMENT OF LINEAR TRANSPORT EQUATIONS IN KINETIC THEORY AND NEUTRON TRANSPORT THEORY Ph.D. Thesis**
William Lyle Cameron 1978 132 p
Avail: Univ. Microfilms Order No. 7814031

The temperature-density equation of kinetic theory and the conservative neutron transport equation are studied. In both cases a modified version of the Larsen-Habetler resolvent integration technique was applied to obtain full-range and half-range expansions. For the neutron transport equation, the method showed notational advantages over previous approaches. In the case of the temperature-density equation, this development extended previous results by enlarging the class of expandable functions. As a natural extension of the kinetic theory results, an integral equation for the surface density is derived for half-space problems involving the boundary condition of arbitrary accommodation.
Dissert. Abstr.

**N78-31889#** Institute for Energy Analysis, Oak Ridge, Tenn.
**ENHANCING PUBLIC ACCEPTANCE OF NUCLEAR ENERGY BY IMPROVING REACTOR SAFETY SYSTEMS**
S. M. Zivi and E. P. Epler Dec. 1977 89 p refs
(Contract EY-76-S-05-0033)
(ORAU/IEA(R)-77-28) Avail: NTIS HC A05/MF A01

A disparity between the views of the public and of the nuclear energy community is identified, wherein the public appears most concerned about the consequences of a large-consequence reactor accident, albeit of low robability, while nuclear energy professionals concern themselves with the actual risks (the product of consequences and probabilities). An appropriate response to public concern is proposed, with greater engineering emphasis on those most improbable accidents which would carry the greatest consequences. Measures are discussed that would lead to virtual assurance against an above-ground rupture of the containment vessel in a pressurized water reactor following a core-melt accident. The accident scenarios analyzed in the Reactor Safety Study (WASH-1400) are reviewed.
ERA

**N78-31890#** Institute for Energy Analysis, Oak Ridge, Tenn.
**AN ACCEPTABLE NUCLEAR FISSION FUTURE Summary Interim Report**
M. J. Ohanian and A. M. Weinberg Dec. 1977 37 p refs
(ORAU/IEA(M)-77-29) Avail: NTIS HC A03/MF A01

The preliminary results of the Institute's examination of the technical and institutional ways of preserving the nuclear option are presented. The main preliminary finding is that nuclear energy ought to be confined to relatively few sites with existing nuclear sites serving as the basis for such a policy. The key elements of a highly collocated system are described with emphasis on strengthened security, professionalism of nuclear personnel, establishment of generating consortia, institutional longevity, and the transition from the LWR-based system to the asymptotic breeder-based system. Brief summaries of the supporting studies in the areas of safety, siting, waste management, legislative and regulatory aspects, and proliferation issues are also included.
ERA

**N78-31891#** General Atomic Co., San Diego, Calif.
**ANALYSIS OF NUCLEAR SYSTEMS SATISFYING US ENERGY NEEDS**
R. F. Turner, R. H. Brogli, D. M. Ligon, and C. J. Hamilton Feb. 1978 35 p refs
(Contract EY-76-C-03-0167-065)
(GA-A-14848) Avail: NTIS HC A03/MF A01

A number of strategies for the development of nuclear power in the U.S. over the next 50 to 60 years were studied systematically. These strategies were evaluated with reference to four vital criteria: (1) limiting the proliferation of nuclear weapon materials, (2) preserving alternatives for assuring a very long term nuclear energy supply to the nation.
ERA

**N78-31892#** Institute for Energy Analysis, Oak Ridge, Tenn.
**TOWARD AN ACCEPTABLE NUCLEAR FUTURE**
A. M. Weinberg Nov. 1977 25 p refs Presented at the Intern. Sci. Forum on an Acceptable Nuc. Energy Future of the World, Ft. Lauderdale, Fla., 7 Nov. 1977
(Contract EY-76-C-05-0033)
(ORAU/IEA(O)-77-31) Avail: NTIS HC A02/MF A01

The nuclear option is in danger of being foreclosed. The trend toward antinuclearism may be reversed if concerns about low-level radiation insult can be shown ultimately to be without foundation; evidence for this speculation is presented. That the nuclear enterprise itself must propose new initiatives to increase the acceptability of nuclear energy is suggested. Cluster siting of reactors is examined as a key element of an acceptable nuclear future. This siting plan might be achieved by confining new reactors essentially to existing sites.
ERA

# 74 OPTICS

Includes light phenomena.

**N78-31893** Arizona Univ., Tucson.
**BLACKBODY SIMULATOR CAVITY RADIATION THEORY Ph.D. Thesis**
Frederick Otis Bartell 1978 156 p
Avail: Univ. Microfilms Order No. 78-13901

A multiple-reflection analysis was performed with the assumptions of gray, Lambertian walls, and a cold aperture. The result is a compacting closed form expression that emphasizes the geometrical effects of the projected solid angle as seen from various points on the back wall of the cavity. A simplified version of the radiation theory was shown to be valid to an accuracy of about 2% for good-quality blackbody simulators used in typical practical applications. This simplified expression was compared with experimental data for conical data for conical, cylindrical, and spherical cavities, and the basic characteristics were confirmed concerning the angular distribution of radiation from blackbody simulator cavities with these three shapes. Recommended procedures are given for determining the approximate value of the effective emissivity of blackbody simulator cavities.
Dissert. Abstr.

**N78-31894** Michigan Univ., Ann Arbor.
**NONLINEAR OPTICAL POLARIZABILITIES OF MOLECULES Ph.D. Thesis**
Charles Kenneth Miller 1978 131 p
Avail: Univ. Microfilms Order No. 78-13703

The technique of dc-electric-field-induced second-harmonic generation (dcSHG) was used to investigate higher-order polarizabilities of molecules in gases, vapors, and a model was developed to describe trends in dipole moments, polarizabilities and hyperpolarizabilities for series of structurally related molecules. A review is given of the relation between microscopic and macroscopic forms of electric tensor properties of both second and third orders. The dcSHG process in a focused laser beam for a particular dc field geometry is also reviewed, and the treatment is extended to include anomalously dispersive gases. Hyperpolarizabilities and hyperpolarizability ratios were measured for the molecules H2, N2, O2, CO, NO, CO2, SF6, NH3, H2S, H2O, (CH3)2O, and CH3OH. The results are presented and compared with theoretical and experimental data from other sources.
Dissert. Abstr.

**N78-31895** California Univ., Berkeley.
**OPTICAL DIFFERENCE FREQUENCY GENERATION OF FAR INFRARED RADIATION Ph.D. Thesis**
James Russell Morris 1977 183 p
Avail: Univ. Microfilms Order No. 78-12704

The theory of far-infrared generation by optical mixing of

monochromatic, focused Gaussian beams in a uniaxial crystal is developed, taking into account the effects of diffraction, absorption, double refraction, and multiple reflections and total reflection at the boundary surfaces. Reflection and transmission coefficients of a uniaxial crystal slab are derived by matrix technique. A theoretical calculation of far-infrared power spectra generated by picosecond pulses in a nonlinear crystal is developed and illustrated with two practical examples: LiNbO3 slabs oriented for rectification of the optical e-ray and for beating of the optical o-ray with the optical e-ray. A pair of ruby-pumped dye lasers and a dual-frequency dye laser system generating continuously tunable far-infrared radiation in the frequency range 20 to 190 cm was used to study forward-, backward-, and non-collinear phase-matching in LiNbO3 at frequencies between 20 and 160 cm. Dissert. Abstr.

**N78-31896** California Univ., Berkeley.
**OPTICAL ROTARY SATURATION Ph.D. Thesis**
Yehiam Prior 1977 167 p
Avail: Univ. Microfilms Order No. 78-12734

A double resonance interaction between a two level system and two fields, a laser field and an electric radio frequency (rf) standing wave, is investigated, and the optical analog of NMR rotary saturation is demonstrated both conceptually and in the details of a mathematical model. The experimental work utilized a Doppler broadened vibrational-rotational transition in methyl fluoride, resonant with one of the lines of a carbon dioxide laser. The results are in good qualitative agreement with the calculations, but due to the degeneracy of the transition and difficulties in obtaining phase sensitive detection, further work is required for a full quantitative examination of the theory.
Dissert. Abstr.

**N78-31897** Johns Hopkins Univ., Baltimore, Md.
**THEORETICAL AND EXPERIMENTAL ASPECTS OF LIGHT SCATTERING FROM THE SURFACE OF LIQUID MERCURY Ph.D. Thesis**
Judith Marie Bates 1978 323 p
Avail: Univ. Microfilms Order No. 78-11793

The different methods for observing a surface transition zone on liquid mercury and its properties are investigated. The Bloch-Rice model for a surface transition zone is reviewed. The notion that light scattering with its vastly larger angular range might provide more information about the transition zone is tested. The theoretical intensities for light scattered from: (1) a perfect conductor, (2) the sharp surface of an imperfect conductor, and (3) an imperfect conductor with a surface transition zone are calculated as a function of incident and scattered angles. The light scattering equations that predict the existence of surface plasmons and their effect on the intensity of scattered light are examined. A technique for measuring surface tension and viscosity through spectral analysis of the scattered light is described. A light beating experiment which could be used to measure the surface tension and surface viscosity of liquid mercury is presented in detail and the results of such an experiment are discussed.
Dissert. Abstr.

**N78-31898** Pennsylvania State Univ., University Park.
**PIEZO-OPTIC PROPERTIES OF LIQUIDS UNDER HIGH PRESSURE Ph.D. Thesis**
Pichet Limsuwan 1978 161 p
Avail: Univ. Microfilms Order No. 78-12061

A high-pressure liquid cell interferometer was designed constructed and used to measure the variation of refractive index (at high pressures) of CCl4 n-pentane, n-hexane, n-heptane, n-octane, n-nonane, n-decane, benzene, chlorobenzene, methyl alcohol, and water at room temperature. In every case the refractive index was found to increase with pressure with pronounced nonlinearity. Expressions prevalent in the literature for the relationship between refractive index and density were analyzed. In general, all the equations give fairly good fits at very low pressures but as the pressure is increased the disagreement between theory and experiment becomes more and more prominent in almost all cases except for the Kirkwood-Brown and Omini equations. Dissert. Abstr.

**N78-31899#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
**ANALYSIS OF A COOPERATIVE STEREO ALGORITHM**
D. Marr, G. Palm, and T. Poggio Oct. 1977 67 p refs
(Contract N00014-75-C-0643)
(AD-A055099; AI-M-446) Avail: NTIS HC A04/MF A01 CSCL 20/6

Marr and Poggio (1976) recently described a cooperative algorithm that solves the correspondence problem for stereopsis. This article uses a probabilistic technique to analyze the convergence of that algorithm, and derives the conditions governing the stability of the solution state. The actual results of applying the algorithm to random-dot stereograms are compared with the probabilistic analysis. A satisfactory mathematical analysis of the asymptotic behavior of the algorithm is possible for a suitable choice of the parameter values and loading rules, and again the actual performance of the algorithm under these conditions is compared with the theoretical predictions. Finally, some problems raised by the analysis of this type of 'cooperative' algorithm are briefly discussed. Author (GRA)

**N78-31900#** Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md.
**HAZARD ANALYSIS OF BROAD-BAND OPTICAL SOURCES**
David H. Sliney, Wesley J. Marshall, Michael L. Carothers, and Richard C. Kaste Dec. 1977 88 p refs
(AD-A054802; USAEHA-TC-084) Avail: NTIS HC A05/MF A01 CSCL 06/18

This technical guide provides an explanation of the techniques used by the Laser Branch, Laser Microwave Division, US Army Environmental Hygiene Agency, to evaluate non-laser optical sources. Hazard criteria and spectral data reduction techniques are explained. Radiometric measurements are not included. The Laser Microwave Division Spectral Weighting Program (LMDSWP--a FORTRAN V computer program) is presented in detail.
Author (GRA)

**N78-31901#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Flugfunk und Mikrowellen.
**OPTICAL MEASUREMENT OF THE RADIO INTERFEROMETER OF THE DFVLR [OPTISCHE VERMESSUNG DES RADIOINTERFEROMETERS DER DFVLR]**
R. Reiser (Fachhochschule Rheinland-Pfalz) and R. Weppner Nov. 1977 32 p In GERMAN Report will also be announced as translation (ESA-TT-483)
(DLR-IB-551-77/13) Avail: NTIS HC A03/MF A01

Adjusting and measurement procedures for the satellite tracking radio interferometer of DFVLR are presented. Topics include direction observation, distance measurement, height measurement. Adjusting procedures for the position of the azimuth center, the vertical position of the azimuth axis, the distance between azimuth and elevation axis, and the elevation axis perpendicular to the azimuth axis are dealt with. ESA

**N78-31302#** Rensselaer Polytechnic Inst., Troy, N. Y.
**IRCCD IMAGING SENSORS: A REVIEW OF DEVICE OPTIONS**
Andrew J. Steckl *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 15 p refs (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

**N78-31309#** General Electric Co., Schenectady, N. Y.
**CHARGE INJECTION DEVICE (CID) HADAMARD PLANE PROCESSOR FOR IMAGE BANDWIDTH COMPRESSION**
G. J. Michon, H. K. Burke, T. L. Vogelnong, and P. A. Merola *In* AGARD Impact of Charge Coupled Devices and Surface Acoustic Wave Devices on Signal Process. and Imagery in Advanced Systems Jun. 1978 5 p Sponsored by AFAL, Wright-Patterson Air Force Base, Ohio (For primary document see N78-31279 22-31)
Avail: NTIS HC A21/MF A01

# 75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**N78-31902** California Univ., Berkeley.
**RAMAN SIDESCATTER INSTABILITY IN A NONUNIFORM PLASMA Ph.D. Thesis**
Michael Alan Mostrom 1977 332 p
Avail: Univ. Microfilms Order no. 7812707

In laser fusion concepts, a density gradient, in the direction of laser incidence, locatize the stimulated Raman instability to a narrow resonance zone where the local plasma wave frequency approximately equals the difference between the incident and scattered electromagnetic waves. This density gradient has a weaker effect on sidescattered waves which propagate perpendicular to it and remain in their resonance zone until refraction bends them out or they exit throught the side of the finite diamter laser beam. The general nature and propagation of the scattered electromagnetic waves are determined and approximate values for the resonance size zone and the time required for saturation are obtained by evaluating the Green function response in time and space. By taking into account the convection of the waves perpendicular to the density gradient, it is shown that the finite laser diameter can typically force an early saturation with the eigenmodes never appearing.
Dissert. Abstr.

**N78-31903** Maryland Univ., College Park.
**MAGNETIC FIELDS IN LASER PELLET PLASMAS Ph.D. Thesis**
Larry Lambert Burton 1977 93 p
Avail: Univ. Microfilms Order No. 78-14016

Mechanisms and models for the generation of megagauss magnetic fields in laser target plasmas discussed include: (1) the generation of magnetic fields in steep steady-profile wavefronts such as ablation waves or shocks propagating across initially field-free nonuniform plasmas or fluids; (2) the effect of amplification by compression of the magnetic field which penetrates from the ablation layer into the target interior; (3) three-dimensional pellet implosion with small departures from spherical symmetry; and (4) aspects of magnetic field generation in laser pellet plasmas including the effects of alpha-particle currents produced following ignition and magnetic field remnants found in the reaction chamber. Dissert. Abstr.

**N78-31904** Maryland Univ., College Park.
**RESONANCE OSCILLATIONS NEAR THE LOWER HYBRID FREQUENCY IN A BOUNDED PLASMA IN A STRONG MAGNETIC FIELD Ph.D. Thesis**
Robert Andrew Gore 1977 99 p
Avail: Univ. Microfilms Order No. 78-12881

A theoretical model which describes electrostatic perturbations in an infinite plasma is developed. This model is shown to be useful in understanding the ion and electron dynamics at the characteristic resonance frequencies of a cold uniform plasma. The characteristic frequencies of the plasma in the University of Maryland Q-machine which occur near the lower hybrid frequency are detected by measuring changes in the quality factor of a solenoidal coupling coil which surrounds the plasma. The scaling of the characteristic frequencies of the plasma with density, magnetic field, and column geometry is found to be in experimental agreement with the theoretical predictions. The coupling of an external power source to a warm plasma column in an external magnetic field and the energy dissipation in a bounded plasma in the Q-machine near the lower hybrid frequency are experimentally studied and results are compared with the theoretical model. Dissert. Abstr.

**N78-31905** Stanford Univ., Calif.
**AXIAL FIELD LIMITATIONS IN MHD GENERATORS Ph.D. Thesis**
William Charles Unkel, Jr. 1978 393 p
Avail: Univ. Microfilms Order No. 78-14215

The results of an experimental and analytical investigation of axial field breakdown in non-slagging wall, combustion-driven MHD generators are presented. Some experiments and analysis were performed for a segmented Faraday generator, however more detail for a simplified configuration in which a voltage was applied to a pair of adjacent electrodes in the absence of a magnetic field were performed. Significant improvements in generator performance can result from prevention of breakdown is shown. Non-slagging wall generators careful thermal design of the inter-electrode region should alleviate the problem of insulator initiated breakdown is indicated. The results also indicate that for both plasma and insulator initiated breakdown reducing the electrode pitch at fixed average current density to the electrode increases for the resistance of channel to breakdown.
Dissert. Abstr.

**N78-31906#** Massachusetts Inst. of Tech., Cambridge.
**A STUDY OF THE DIFFUSION OF TRACER IMPURITIES IN THE VERSATOR 1 TOKAMAK PLASMA BY SPECTRAL EMISSIONS IN THE VACUUM ULTRAVIOLET RANGE M.S. Thesis**
George Patrick Lasche May 1977 65 p refs
(AD-A054756) Avail: NTIS HC A04/MF A01 CSCL 20/9

Diffusion of impurity ions was studied by artificially injecting neon gas into the Versator I Tokamak (n sub e about 2 x 10 to the 13th power/cu. cm., T sub e about 150 eV, toroidal magnetic field about 5.5 kG, pulse duration about 7 msec, plasma current about 5 kA). Small amounts of neon gas were injected into the Tokamak by means of a pulsed piezo-electric valve. The absolute line intensity of vacuum ultraviolet radiation in the range of 400 to 1600 A, emitted from ions which had been 3 to 7 times ionized, was observed as a function of time, and along twenty-one chords across the plasma column. The local density of neon in the plasma in space and time was determined by use of Abel inversion. From this an experimental value for the flux rate of this impurity into the plasma was inferred.
Author (GRA)

**N78-31907#** College of William and Mary, Williamsburg, Va.
**EFFECTS OF PRESSURE ANISOTROPY ON THE STABILITY OF THE GUIDING CENTER PLASMA Progress Report, 15 Sep. 1976 - 14 Dec. 1977**
George Vahala 1977 26 p refs
(Contract EY-76-S-05-5260)
(ORO-5260-1) Avail: NTIS HC A03/MF A01

The stability analysis of nearly cylindrical magnetically confined plasma is generalized to include effects of pressure anisotropy in the guiding center model of grad. The equilibrium and normal mode equations for helically symmetric plasmas were examined. These equations reduced all previous diffuse profile bumpy theta pinch and helical calculations (in the appropriate limits) are shown. A conjecture, based on the inverse cascade of magnetic helicity, to explain J. B. Taylor's hypothesis for reversed field pinches is presented. ERA

**N78-31908#** Department of Energy, Washington, D. C. Div. of Magnetic Fusion Energy.
**ALLOYS FOR THE FUSION REACTOR ENVIRONMENT: A TECHNICAL ASSESSMENT**
Jan. 1978 102 p refs
(DOE/ET-0007) Avail: NTIS HC A06/MF A01

This technological assessment includes the following: (1) primary and backup materials of choice, (2) testing and manpower requirements, (3) major milestones, (4) natural resources and industrial capability, and (5) conclusions. The first wall/blanket structure was emphasized in the assessment of materials subject to intense radiation. ERA

**N78-31909#** Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
**DIFFUSION OF MONOENERGETIC PHOTOELECTRON FLUXES INSIDE THE PLASMASPHERE**
G. Lejeune 5 Sep. 1977 38 p refs Submitted for publication
(CEPHAG-39/77) Avail: NTIS HC A03/MF A01

The study on the influence of diffusion on a photoelectron flux inside the plasmasphere by Lejeune and Wormser, 1976, was extended by considering monoenergetic boundary photoelectron fluxes. Any boundary flux can be achieved by the superposition of such fluxes, and the transmission and reflection coefficients

obtained for monoenergetic fluxes are fitted by formulas which allow calculation of the transmission and reflection of any boundary flux. A good knowledge of the evolution of monoenergetic fluxes was necessary to studies such as the Mantas et al, (I977) paper including both ionospheric and plasmaspheric photoelectron transfers. It can also be useful to interpret energy deposit or fluxes along a field line in active experiments. Author (ESA)

# 76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

**N78-31910** California Univ., Berkeley.
**NUCLEATION PHENOMENA IN THE FORMATION ELECTRON-HOLE DROPS IN Ge Ph.D. Thesis**
Robert Moore Westervelt 1977 223 p
Avail: Univ. Microfilms Order No. 78-12823

A detailed theory of the nucleation of electron-hole drops (EHD) from a gas of free excitons (FE) in Ge is presented, together with a systematic experimental study of hysteresis and threshold phenomena in the luminescence of optically excited crystals of ultrapure Ge. The non-equilibrium rates of EHD formation and breakup and the concentration of EHD in dynamic equilibrium with the FE gas were calculated including the effects of the EHD surface energy w and the EHD lifetime. Large metastable and non-equilibrium effects are found. These results were used to quantitatively predict for Ge under continuous excitation: (1) the EHD concentration and size vs. excitation level and history of excitation; (2) the metastable time development of the EHD concentration; (3) mathematically well-defined FE density thresholds for the formation and destruction of EHD and thus the FE-EHD phase diagram including the effects of metastablity and the EHD lifetime; (4) a procedure to accurately determine the EHD surface energy from the threshold data; and (5) limits to the steady-state EHD radius vs. temperature.
Dissert. Abstr.

**N78-31911** Purdue Univ., Lafayette, Ind.
**DYNAMICS OF INCOMMENSURATE CHARGE DENSITY WAVES IN ELECTRIC AND MAGNETIC FIELDS Ph.D. Thesis**
Mark Louis Boriack 1977 96 p
Avail: Univ. Microfilms Order No. 7813032

The equations of motion for the drift velocity of the charge density wave (CDW), the electron drift velocity, and the total electric current are microscopically derived for a three-dimensional system containing an incommensurate CDW in the presence of electric and magnetic fields and scattering processes. The effective mass characterizing the acceleration of the CDW by an electric field is shown to be equal to that for the magnetic field. The effects of a drifting CDW on the magnetotransport properties in the case of a simply connected Fermi surface were examined. The theory of the induced-torque experiment for a spherical sample containing a single CDW which is free to drift is discussed. Dissert. Abstr.

**N78-31912** Montana State Univ., Missoula.
**THERMODYNAMIC INTERPRETATION OF SECONDARY ION AND PHOTON EMISSION DURING SPUTTERING OF SILICON Ph.D. Thesis**
Ronald Albert Burghard 1977 145 p
Avail: Univ. Microfilms Order No. 78-12901

Secondary ion mass spectrometry (SIMS) and sputter-induced photon emission (SIPE) data were analyzed using local thermodynamic equilibrium (LTE) models. The data were obtained from silicon samples doped with boron, phosphorus, and arsenic, using argon, nitrogen, and oxygen beams. The existence of LTE at the surface of solids during sputtering was checked by comparing the temperature obtained from the secondary ions with those obtained from the photons emitted. The temperatures obtained from the secondary ion data were 8400 K for N2(+) bombardment and 11,000 K for 02(+) bombardment. The temperatures obtained from the photon emission data were 4240 K, 4860 K, and 4450 K for argon, nitrogen, and oxygen bombardment, respectively. Thus, LTE does not appear to exist at the surface of solids during sputtering. Dissert. Abstr.

**N78-31913** Stanford Univ., Calif.
**ELASTIC PROPERTIES OF ONE-DIMENSIONAL CONDUCTORS AND SEMICONDUCTORS Ph.D. Thesis**
Joseph Warren Brill 1978 210 p
Avail: Univ. Microfilms Order No. 78-14160

The measurement of Young's modulus and internal friction by a vibrating reed technique as a means of locating and categorizing structural phase transitions in one dimensional compounds was investigated. Several materials were studied. The existence of a lattice distortion in trimethyl ammonium iodide tetracyano quino dimethane at 157K was confirmed; in addition, a larger, first order transition was found at 89K which has been ascribed to the freezing out of methyl rotations. In alpha palladium benzo quinone dioxamate, a large elastic anomaly at 90K was observed. Of the two phase transitions known to exist in niobium triselenide, only that at higher temperatures (142K) was detected, indicating a large anisotropy in the stress dependence of the lower transition temperature (58K). Measurements were also made on the partially oxidized potassium and ammonium cyano platinates. Dissert. Abstr.

**N78-31914** Georgetown Univ., Washington, D.C.
**PIEZORESISTIVITY AND ITS MAGNETIC FIELD DEPENDENCE IN N-TYPE INDIUM-ANTIMONIDE Ph.D. Thesis**
Clifford William Chapman 1977 191 p
Avail: Univ. Microfilms Order No. 7814082

Variations in the resistance of InSb were measured as a function of stress and magnetic field. Piezoresistance and magnetoresistance have been calculated for transverse and longitudinal (CH76)100,(CH110)(CH76)110(CH110) and (CH76) 111(CH110) crystallographic directions. Zero field piezoresistivity was used to calculate the three deformation potential constants for this face-centered cubic semiconductor. Analysis of the magnetic field effects shows that the linear dependence of the magnetoresistance and the decrease in piezoresistivity with field strength can be attributed to quantum effects. The results also show that the classical theories for galvanomagnetic effects in this semiconductor are no longer valid at a temperature of 4.2K and for fields in excess of 2000 Gauss. Dissert. Abstr.

**N78-31915** California Univ., Berkeley.
**ELECTRON SPECTROSCOPY AND LOW-ENERGY ELECTRON DIFFRACTION STUDIES OF SILICON AND TITANIUM OXIDE SURFACES Ph.D. Thesis**
Yip-Wah Chung 1977 162 p
Avail: Univ. Microfilms Order No. 7812522

The first part deals with chemisorption of acetylene, oxygen and aluminum on the silicon (111)surface as studied by Auger and electron energy loss spectroscopy and low energy electron diffraction. These studies suggest that the absorption of acetylene on the silicon (111) - (7x7) surface takes place on preferred sites, due to the interaction of the silicon surface dangling bond orbitals and the pi orbitals of the acetylene molecules. In the second part, titanium oxide and strontium titanate surfaces were studied. The clean Ti02(110) surface is unreconstructed while the (100) surface reconstructs to give (1 x 3),(1 x 5)and(1 x 7) surface structures when annealed at 500 , 800 and 1200 deg C respectively. There is an accompanying decrease in surface oxygen concentration with increasing annealing temperature. Prolonged argon ion bombardment removes oxygen preferentially and results in a surface composition close to Ti203, ans shown by Auger measurements. Dissert. Abstr.

**N78-31916** Missouri Univ. - Columbia.
**SURFACE AND BULK ELECTRONIC PROPERTIES OF d-BAND PEROVSKITES Ph.D. Thesis**
Sinasi Sueleyman Ellialtioglu 1977 120 p
Avail: Univ. Microfilms Order No. 78-14114

The surface and bulk electronic structures of cubic d-band perovskites were calculated using a semiempirical LCAO model which included the p-orbitals of the oxygen ions and the d-orbitals of the transition metal ions. It is found that the surface states are forced out of the band-gap region by the intraatomic Coulomb interaction among excess electrons on surface cation sites. Analytical formulae for the electronic density of states were derived

including all of the fourteen primary energy bands of the cubic perovskites. The theoretical results are shown to be in excellent agreement with numerical energy band calculations for SrTiO3, KTaO3, ReO, and NaWO3. Dissert. Abstr.

**N78-31917** Illinois Inst. of Tech., Chicago.
**THE PHOTOMECHANICAL EFFECTS AS MEASURED BY FRACTURE SURFACE ENERGY IN KCl Ph.D. Thesis**
Pritam Singh 1977 172 p
Avail: Univ. Microfilms Order No. 78-11826

The photomechanical effect in gamma-irradiated KCl at approximately 64 K was investigated using the Obreimov-Gilman double-cantilever technique. The value of fracture surface energy were widely scattered, which is characteristic of the fracture process. In spite of this, the effect of illumination with white light was unmistakably to increase the fracture surface energy. An explanation of the observed PME was sought in terms of electrostatic and elastic interactions between dislocations and point defects. Formation of charged jogs by illumination causes pinning of dislocations. Illumination is also instrumental in increasing the elastic interaction between dislocations and point imperfections, and so decreases their mobility. Dissert. Abstr.

**N78-31918** State Univ. of New York at Albany.
**STATISTICAL PROPERTIES OF PARTICLES CONFINED BY IRREGULAR SURFACES Ph.D. Thesis**
Judith Fibkins Tavel 1978 245 p
Avail: Univ. Microfilms Order No. 7813973

A perturbation theory is developed which calculates the eigenvalues and eigenfunctions of a Hamiltonian operator in a deformed domain by relating the original operator in its complicated domain to a perturbed operator in a simple domain. Using this theory, the level structure of conduction electrons in small metal particles having various degrees of surface deformation was calculated. It is shown that the distribution of level spacings in such particles can be described by the Winger distribution if the surfaces are maximally random; i.e., described by an infinite sum of spherical harmonics with randomly chosen coefficients. If the particles have smoother surfaces; i.e., having higher harmonics damped out; their level spacing distributions have a large number of small spacings which give rise to a maximum at the origin of the level spacing distribution and therefore differ markedly from the Wigner distribution.
Dissert. Abstr.

**N78-31919** Stanford Univ., Calif.
**INCAPSULATION AND ANNEALING OF ION IMPLANTED SELENIUM IN GaAs Ph.D. Thesis**
Alexander Lidow 1978 173 p
Avail: Univ. Microfilms Order No. 78-14184

Gallium arsenide was encapsulated to withstand annealing temperatures over 1100 C by using a double layered encapsulant consisting of arsenic doped silicon dioxide on top of plasma deposited silicon nitride. Samples encapsulated in such a manner and annealed show no signs of mechanical failure and yield higher electrical activation of ion implanted selenium when compared with samples annealed with silicon nitride only. In addition, there is no detectable outdiffusion of Ga or As and no detectable indiffusion of Si. Peak electrical activation of ion implanted Se was measured as 1.0 x 10 to the 19th power carriers/cu cm for samples annealed at 1100 C. The development of this encapsulant is shown to be essential for the study of diffusion of ion implanted elements in GaAs such as selenium.
Dissert. Abstr.

**N78-31920** Oregon Univ., Eugene.
**ELECTRON SCATTERING RATE ANISOTROPY AND CONDUCTION ELECTRON-4-f MOMENT INTERACTIONS IN Au(RARE EARTH) DILUTE ALLOYS Ph.D. Thesis**
Catherine Gei-inn Lin-Hendel 1978 234 p
Avail: Univ. Microfilms Order No. 7814321

A de Haas-van Alphen effect study of conduction electron-rare earth local moment interactions was made using three Au (rare earth) dilute alloy systems: Au(Gd), Au(Ho)and Au(Yb). Electronic scattering rate anisotropy (in k-space)was measured for all three systems for six orbits in the (110)plane. A third harmonic waveshape analysis technique was developed for exchange interaction measurements. Explicit expressions for the de-Haas-van Alphen harmonic relative phases and amplitude ratios were derived in terms of (the exchange-shifted cyclotron orbital g-value, the spin dependent scattering rate, and the mean electronic scattering rate). Gd impurities caused a ferromagnetic shift of the Zeeman-split Landau levels of the host conduction electrons. Yb caused an anti-ferromagnetic shift. Ho behaved as if being non-magnetic (no exchange shift). Dissert. Abstr.

**N78-31921** Syracuse Univ., N. Y.
**ELASTOPHOTOCONDUCTANCE IN POLYCRYSTALLINE FILMS OF CADMIUM-SULFIDE Ph.D. Thesis**
Amaresh Mahapatra 1977 134 p
Avail: Univ. Microfilms Order No. 7813317

The modulation of the photoconductivity of polycrystalline films of Cds by elastic strain was studied. The CdS films were vacuum deposited on soda-lime glass substrates and heat treated to yield films with light to dark conductivity ratios of 10,000 at 20 ft.CdS. Elastic strains were generated in the film by propagating Rayleigh waves (surface acoustic waves) in the glass substrate.The fractional change in conductivity due to strain shows prominent maxima and minima as a function of light intensity. The largest recorded fractional change in conductivity is about 0.001 at strains of the order 10 to the minus 7 power. This is a much larger change than has been observed in single crystals of CdS. Dissert. Abstr.

**N78-31922** Virginia Univ., Charlottesville.
**MAGNETIC INTERACTIONS IN THE HUBBARD MODEL Ph.D. Thesis**
Pavlos Michael Mihas 1977 113 p
Avail: Univ. Microfilms Order No. 78-12136

The Hubbard model is treated with the binary self consistent approximation. Within this approximation magnetic moments are introduced self consistently. The Ising type interactions were calculated explicitly in the limit of small temperature. Relaxing the static character of the approximation the interactions are transformed to Heisenberg type and are renormalized in their size. By introducing a magnetic field, the values of short range order and of the moments change. The self consistent bands are displaced and distorted. For small magnetic field several approximations are applied. The change of the moments is found proportional to H2. The negative magnetoresistance of extrinsic semiconductors is explained as a elimination of moments. The persisting disagreements with certain experimental data are explained as effects of metastability. Dissert. Abstr.

**N78-31923** Purdue Univ., Lafayette, Ind.
**BRILLOUIN SCATTERING OF REFLECTED LIGHT BY THE BULK ACOUSTIC PHONONS IN GaAs AND CdS Ph.D. Thesis**
Satchidanand Mishra 1977 238 p
Avail: Univ. Microfilms Order No. 7813090

The properties of Brillouin scattering of reflected light, and its advantages and limitations in the study of bulk and surface acoustic waves in both transparent and opaque materials are presented. The analysis of reflected light scattering provided a measure of the amplitude of the mechanical ripples, and of the atomic displacements associated with the amplified shear waves. The magnitudes of such displacements were measured on different crystallographic faces of a crystal. The atomic displacements on the surface do not necessarily coincide with the known displacements in the bulk of crystal. Although the correlation is very good for shear waves propagating in the basal plane in CdS, in GaAs atomic displacements of equal strength on surfaces parallel and perpendicular to the displacements in the bulk were found. The nature of the bulk modes and their atomic displacements may be different near the surface than in the interior, depending on the crystal structure. Dissert. Abstr.

**N78-31924** Stanford Univ., Calif.
**ELECTRON TUNNELING INTO THE A15 SUPERCONDUCTORS: Nb3Sn, V3Si, AND Nb3Ge Ph.D. Thesis**
David Frank Moore 1978 164 p
Avail: Univ. Microfilms Order No. 78-14194

Oxide-layer tunnel junctions are described which have outstandingly good quasiparticle (Giaever) and pair (Josephson) tunneling characteristics. The junctions were made on thin films of niobium tin and vanadium-3-silicon. Good thin films made in

a multi-electron-beam coevaporation system formed tunneling barriers by oxidation of the evaporated niobium-tin films in air at room temperature before deposition of a lead or aluminum counterelectrode. In the case of vanadium-silicon the thermal oxide produced junctions with very poor current-voltage characteristics. However, the deposition of an extra silicon layer between two and sixteen nanometers thick on the fresh vanadium-silicon films before exposure to air resulted in excellent tunnel junctions. Dissert. Abstr.

**N78-31925** State Univ. of New York at Buffalo.
**QUANTUM THEORY OF CYCLOTRON RESONANCE LINESHAPE FOR THE INVERSION LAYER ELECTRONS IN METAL-OXIDE-SEMICONDUCTOR (MOS) Ph.D. Thesis**
Mahendra Prasad 1977 95 p
Avail: Univ. Microfilms Order No. 78-10653

Kubo's correlation function formula and Fujita's proper connected diagram technique were used to develop a quantum theory of cyclotron resonance lineshape for a two dimensional electron impurity and electron phonon system. Equations for the cyclotron resonance linewidths and the frequency shifts, associated with the electronic transitions between Landau subbands N and N + 1 are derived by making use of very high resonant magnetic field approximation. Equations for the linewidth are solved and calculated for the Gaussian, Coulomb and screened Coulomb interactions. The temperature dependent cyclotron resonance linewidth of inversion electrons in MOS may be thought to arise from the inelastic scattering of the electrons with acoustic phonons. Dissert. Abstr.

**N78-31926** Syracuse Univ., N. Y.
**ANOMALOUS HALL EFFECT AND OSCILLATORY PHOTOCONDUCTIVITY IN p-TYPE MERCURY CADMIUM TELLURIDE Ph.D. Thesis**
Kevin James Riley 1977 221 p
Avail: Univ. Microfilms Order No. 78-11678

Single crystals of mercury cadmium telluride were grown by solid state recrystallization and slush recrystallization. Each technique was characterized by Berg-Barrett X-ray topography in order to determine optimum growth parameters. Optimum growth parameters for solid state recrystallized ingots of Hg(1-x)(d(x)Te were a quench rate of 50 el/min, a mercury partial pressure of 20 atm and an anneal temperature of 690 C. For slush recrystallization optimum growth of Hg(1-x)(d(x)Te crystals was achieved with initial compositions of 7 percent and a temperature gradient of 10 C/cm. The temperature dependence of the Hall effect, resistivity, and photoconductive response was measured for both n-type and p-type samples. The Hall curves and photoconductive spectra for n-type samples show a classical behavior whereas lightly doped p-type samples have a negative Hall coefficient which shows either a broad dip or a freeze-out region and an oscillatory photoconductive spectra at low temperatures. Dissert. Abstr.

**N78-31927#** Honeywell Corporate Material Sciences Center, Bloomington, Minn.
**STUDIES OF INDIUM-DOPED SILICON Semiannual Report, 1 Aug. 1977 - 31 Jan. 1978**
M. W. Scott, C. E. Jones, and R. J. Hager 31 Jan. 1978 60 p refs
(Contract DAAK70-77-C-0914; ARPA Order 3211)
(AD-A054479; HONEYWELL-47305) Avail: NTIS HC A04/MF A01 CSCL 20/12

The objectives of this program are to obtain a better understanding of the properties of indium acceptors in silicon, and to develop a new growth procedure which will yield better quality material than is possible by conventional melt-growth techniques. During this program the feasibility of growing indium-doped silicon by the gradient-transport solution growth process was demonstrated. Eight crystals have been grown over the 1000 C to 1300 C temperature range to determine the Si-In solidus curve. The maximum solubility of indium in silicon was determined to be 1.6 x 10 to the 18th power/cc from these measurements. The peak absorption coefficient due to the indium was found to be 1/82 cm in the crystal grown at 1300 C. Effective mass-like spectra due to shallower acceptors in both indium and aluminum-doped silicon have been observed for the first time. The spectra corresponds to the indium:X defect at 112.8 meV and to the aluminum: X defect at 56.3 meV. Deep level transient capacitance spectroscopy (DLTS) has been used to measure the trapping parameters of indium acceptors. The capture cross section for holes by the indium centers has been determined to be greater than 10 to the -13th power sq. cm. at 65K from these measurements. Author (GRA)

**N78-31928#** Raytheon Co., Waltham, Mass. Research Div.
**ELECTRICAL TRAPS IN MICROWAVE MATERIALS Final Report, 1 Mar. 1975 - 28 Feb. 1978**
Lowell H. Holway, Jr. and Michael Adlerstein May 1978 113 p refs
(Contract F44620-75-C-0063; AF Proj. 2306)
(AD-A055086; S-2333; AFOSR-78-0980TR) Avail: NTIS HC A06/MF A01 CSCL 20/12

This program was the final year of a three-year program to identify the sources of trapping centers in gallium arsenide semiconductor devices, to correlate this evidence with device effects and to eliminate or minimize these effects. During the first year of the program we assembled measurement apparatus and established a technique, based on drain current transients, in determining trap activation energies on GaAs FET's using a modification of deep level transient spectroscopy (DLTS). During the second year we applied the new DLTS measurement technique, and variations of it, to numerous samples chosen to provide comparisons of different growth and device processing methods. The data has been supplemented by other pulsed and optical experiments which are described in the Second Interim Report. During the final year, we used transient capacitance DLTS techniques by utilizing special FET structures (fat FET's) and specially-doped test wafers. A hole trap (at 0.45 eV due to copper) was identified in p-GaAs and an electron trap at 0.34 eV in an n-GaAs IMPATT diode was detected. A technique was devised for identifying trap energy levels from a single DLTS temperature sweep. Surface traps, whose signature differs qualitatively from bulk trap signatures, were discovered in FET wafers. GRA

**N78-31929#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**ELECTRICAL PROFILING OF MAGNESIUM IMPLANTED GALLIUM PHOSPHIDE M.S. Thesis**
David James Lank Dec. 1977 80 p refs
(AD-A055195; AFIT/GE/EE/77-38) Avail: NTIS HC A05/MF A01 CSCL 20/12

Differential Hall measurements by the van der Pauw technique were taken to provide a profile of the electrically active carriers in ion implanted GaP. The study was limited to magnesium implants at room temperature at an implant energy of 129 KeV. Annealing was done in a flowing argon atmosphere at 900 C. The profiles indicated a decreasing carrier density as the depth increased. The peak of the profile was at or near the surface. In none of the cases observed were the results as predicted by the LSS theory. They were, however, much in accordance with the theory developed by Large and Bicknel for low energy implants. Glow Discharge Optical Spectrography (GDOS) profiles taken also indicated the same type of carrier distribution. Temperature dependence and cap dependence tests were also carried out. The results indicated that pyrolytically deposited Si3N4 annealed at 900 C provided the best percentage of type conversion. Author (GRA)

**N78-31930#** General Electric Co., Schenectady, N. Y. Corporate Research and Development.
**RESEARCH ON ALUMINUM NITRIDE MATERIALS Final Technical Report, 1 Nov. 1976 - 31 Oct. 1977**
Glen A. Slack and Thomas F. McNelly Mar. 1978 27 p refs
(Contract F44620-76-C-0039; AF Proj. 2306)
(AD-A054980; SRD-78-051; AFOSR-78-0937TR) Avail: NTIS HC A03/MF A01 CSCL 20/2

This report summarizes the progress made during the second year of AFOSR contract support in growing single crystals and producing ceramic samples of aluminum nitride for use as electronic heat sinks and surface acoustic wave (SAW) devices. An improved aluminum pellet-drop technique for making 70-g quantities of ALN starting material has been developed. By subliming and recondensing this material in sealed tungsten crucibles at temperatures between 2100 C and 2350 C, crystals

up to 1.2 cm in length and 0.4 cm in diameter have been grown. The problem of pinhole attack of tungsten by ALN has been studied in detail, and a technique for producing long-lived crucibles using W foil has been developed. GRA

**N78-31931#** Naval Surface Weapons Center, White Oak, Md. Research and Technology Dept.

**DOMAIN ORIENTATION IN SINGLE CRYSTAL TbFe(2) AND Tb(.27)Dy(.73)Fe(2)**

R. S. Sery and H. T. Savage 29 Nov. 1977 20 p refs
(SF11112160)
(AD-A055025; NSWC/WOL/TR-77-182) Avail: NTIS HC A02/MF A01 CSCL 20/2

The investigators have observed 71 and 109 degree walls in single crystal TbFe(2) and Tb(.27)Dy(.73)Fe(2) (Terfenol) via the Kerr effect and synchrotron radiation topographs. A Terfenol (110) surface exposed to synchrotron radiation showed stripe-like domains with (110), 109 degree walls and (001), 71 degree walls. Cooling to approx. 273K caused an easy axis switch from -111= to -100=; no domains were visible. Warming back to approx. 293K brought out mostly 109 degree walls. Stripelike domains were also seen in (110) and (100) TbFe(2) surfaces via the Kerr effect. In the (110) sample H fields along (001) and (110) directions created 109 and 71 degree walls respectively. With H applied at approx. 45 degree to both (001) and (110) directions 71 and 109 degree walls appeared simultaneously. The domain widths varied from 5 to 250 micrometers and fields of approx. 3000 Oe away from (001) and (110) directions saturated the sample. Walls in the (100) sample were also 71 or 109 degree but were only 2 to 15 micrometers wide. GRA

**N78-31932#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**USE OF A METAL-NITRIDE-OXIDE-SEMICONDUCTOR AS THE DETECTOR FOR A RADIATION DOSIMETER M.S. Thesis**

Ronald Guy Fraass Mar. 1978 57 p refs
(AD-A055187; AFIT/GNE/PH/78M-3) Avail: NTIS HC A04/MF A01 CSCL 06/18

A method of radiation dosimetry using a Metal-Nitride-Oxide-Semiconductor (MNOS) device as the detector was developed and partially evaluated. The MNOS devices are capable of measuring doses from 10 k rads to 4 M rads. Repeatability of observations indicates a precision of - or - 1% of total dose from 200 k rads to 4M rads (Si). Dosage in rads is obtained by reference to a calibrated source exposure rate and not to dose absorbed within the dosimeter. A Co60 source was used for all radiation testing. Schematics are given for some of the circuits tested. Determination of dosage from the system is indirect and requires the use of a calibration curve. Each dosimeter must be calibrated from a known source. Direct readout of dose is suggested by use of a microprocessor. Exposure to 20,000,000 rads did not degrade performance. Devices eventually failed due to charge migration from the large integrated circuit chip on which they were fabricated. Discrete, non-stepped gate MNOS transistors are recommended. Author (GRA)

**N78-31933#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**DEEP LEVEL TRAP SPECTROSCOPY OF GALLIUM ARSENIDE M.S. Thesis**

Clarence E. Mayo Mar. 1978 82 p refs
(AD-A055198; AFIT/GE/EE/78-4) Avail: NTIS HC A05/MF A01 CSCL 20/12

Trapping states in epitaxial GaAs induced by 1 MeV electron irradiation were measured by transient capacitance. N-type epitaxial GaAs samples with buffer layer were irradiated at room temperature with 1 MeV electrons, at doses ranging from 10 to the 14th power/sq.cm to 10 to the 16th power/sq.cm. Carrier removal, changes of concentration profile, diode behavior, and C-V characteristics were measured as a function of electron dose. Transient capacitance spectroscopy techniques were used to measure deep trapping levels between 4 K and 450 K. Concentrations of trapping states as a function of electron dose were measured and related to the carrier concentration measurements. The usual electron-induced trapping states with significant variations were noted. Variations of spatial depth of the traps as a function of irradiation and thermal cycling were observed. Samples were in the form of FET test patterns for correlation of material properties and device performance. Author (GRA)

**N78-31934#** Princeton Univ., N. J. Materials Lab.

**RADIATION EFFECTS ON MOS/SOS SEMICONDUCTOR DEVICES**

B. S. H. Royce May 1978 51 p refs
(Contract DAAG39-76-C-0070)
(AD-A055925; HDC-CR-070-1) Avail: NTIS HC A04/MF A01 CSCL 09/1

Measurement have been made on radiation induced leakage currents in MOS/SOS structures and the effects of optical bleaching and further irradiation under zero bias conditions have been studied. In order to understand the role played by bulk traps in Al2O3 in the radiation induced leakage currents and to identify the possible lattice defects associated with these traps, Thermally Stimulated Current Techniques have been employed on samples of single crystal Al2O3 from various sources. Optical bleaching and trap repopulation studies have been made in conjunction with the thermally stimulated current measurements. A review of data on trapping states in Al2O3 is presented and models for the trapping and charge compensation processes involved in the back channel leakage are discussed.

Author (GRA)

**N78-31935#** Cornell Univ., Ithaca, N. Y.

**DIRECT OBSERVATION OF GRAIN BOUNDARY DIFFUSION BY SCANNING AUGER MICROSCOPY**

A. P. Janssen, J. C. M. Hwang, J. A. Venables, and R. W. Balluffi Aug. 1977 8 p
(Contract EY-76-S-02-2679)
(COO-2679-14) Avail: NTIS HC A02/MF A01

Scanning Auger electron microscopy revealed the diffusion of silver at relatively low temperature along grain boundaries in gold films, and its subsequent diffusion over the surface of the films. The results point the way to quantitative studies of grain boundary and surface diffusion coefficients on a microscopic scale. ERA

**N78-31936#** Los Alamos Scientific Lab., N. Mex.

**QUARTZ CRYSTAL MICROBALANCES: A REFINED TECHNIQUE FOR DETERMINING CHANGES IN MASS LOADING FROM FREQUENCY SHIFTS**

M. M. Fowler and William A. Sedlacek Mar. 1978 15 p refs
(Contract W-7405-eng-36)
(LA-7106-MS) Avail: NTIS HC A02/MF A01

Current methods of converting quartz crystal microbalance frequency shifts to mass are frequently quite inaccurate. An improved method is presented which reduces the error to a fraction of a percent. The algorithm requires a knowledge of the crystal function and the mass loading distribution. ERA

**N78-31937#** California Univ., Berkeley. Lawrence Berkeley Lab.

**QUANTIZING THE POLARIZATION OF LEAD ZIRCONATE-TITANATE**

S. W. Hewett Dec. 1977 38 p refs
(Contract W-7405-eng-48)
(LBL-7322) Avail: NTIS HC A03/MF A01

The polarization of polyerystalline lead zirconate-titanate ceramics was investigated. Thin disks were wintered from compacts of calcined lead zirconate-titanate with various stoichiometry and dopants. A packing powder technique was used to control lead oxide loss during firing. The charge displaced during poling was measured using a Sawyer-Tower circuit at various poling temperatures. The resonant and antiresonant frequencies were measured 24 hrs. after poling to determine the planar coupling coefficient and mechanical quality factor for all samples. It is shown that the saturation polarization for all undoped samples is 161 micron C/sq cm regardless of the poling temperature. This value is 82% of the saturation polarization estimated for a single crystal. The piezoelectric constants show no correlation with poling temperature in the range studied as long as saturation polarization is achieved. The electric field required for saturation polarization was plotted against temperature so the the required field could be estimated at any given temperature. ERA

**N78-31938#** California Univ., Berkeley. Lawrence Berkeley Lab.
**MULTIPERIPHERAL RING DYNAMICS AND A DEFINITION OF THE COMPLETE TWISTED REGGEON LOOP Ph.D. Thesis**
P. H. Lucht Nov. 1977 130 p refs
(Contract W-7405-eng-48)
(LBL-6199) Avail: NTIS HC A07/MF A01

The t less than 0 multiperipheral formalism of Ciafaloni, DeTar, Misheloff, Mueller, Muzinich and Yesian is reviewed, extended, and applied to the ordered S-matrix whose ring amplitudes comprise the zeroth level of the topological expansion. Toller M-function notation is used throughout. The bootstrap and cylinder problems are formulated in terms of a well defined helicity pole propagator; a definition of the complete twisted Reggeon loop, which appears in the one-twist term of the cylinder, is given as a helicity pole expansion. Some consideration is given to the following subjects: diagonalization, naturality, threshold behavior, Regge cuts, and complex helicity. ERA

**N78-31939#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Werkstoff-Forschung.
**INVESTIGATION OF PHASE EQUILIBRIA OF TaC FIBER REINFORCED COBALT ALLOYS HAVING A DIRECTIONALLY SOLIDIFIED EUTECTIC STRUCTURE AIMED AT MATRIX HARDENING Ph.D. Thesis - Tech. Hochschule Aachen**
Adolf Donner 3 Jan. 1978 82 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-513)
(DLR-FB-77-58) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 35,80

The possibility of improving the 900 C creep strength of directionally solidified two phase eutectic alloys by precipitation of a third phase which is stable at high temperatures, was investigated. It was found that: 1) the aluminum content necessary for the precipitation of aluminum nitride has an insignificant effect on the eutectic equilibrium of (Co, Cr, Ni)-TaC. This enables the precipitation of aluminum nitride particles subsequent to directional solidification; 2) By varying the composition in the system (Co, Cr, Ni)-TaC as well as the precipitation of Mc carbides by the addition of tungsten, niobium and molybdenum the precipitation of Co2 Ta results in such significant changes in the eutectic equilibrium that the directional solidification is prevented.
Author (ESA)

# 77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

**N78-31940#** California Univ., Berkeley. Dept. of Chemical Engineering.
**ON THERMODYNAMICS AND THE NATURE OF THE SECOND LAW FOR MIXTURES OF INTERACTING CONTINUA**
A. E. Green and P. M. Naghdi Feb. 1978 45 p refs
(Contract N00014-75-C-0148; NR Proj. 064-436)
(AD-A055102; UCB/AM-77-8) Avail: NTIS HC A03/MF A01 CSCL 20/13

This paper, which may be regarded as a continuation of a previous paper on thermodynamics of single phase continua, is concerned with a new approach to thermomechanics of multiphase continua and extends the previous ideas and procedure to mixtures of interacting continua. In particular, it contains a proposal of a new approach for obtaining restrictions on constitutive equations, an appropriate mathematical statement of the second law for mixtures and the nature of restrictions placed by the latter on constitutive results representing the thermomechanical behavior of mixtures with different constituent temperatures. Our point of departure is the introduction of balances of entropy and the use of a single energy equation for the whole mixture as an identity for all motions and all temperature distributions after the elimination of the external fields. GRA

**N78-31941#** Naval Academy, Annapolis, Md. Div. of Engineering and Weapons.
**THE DYNAMIC THEORY, A NEW VIEW OF SPACE, TIME, AND MATTER**
Pharis Edward Williams Mar. 1978 195 p refs
(AD-A055325; USNA-EW-6-78) Avail: NTIS HC A09/MF A01 CSCL 20/10

The proposed Dynamic Theory adopts generalizations of the three classical thermodynamic laws and is shown to produce a unique unifying effect by displaying that the fundamental principles of Newtonian and relativistic mechanics, Einstein's General Theory, Maxwell's electromagnetism, thermodynamics, and quantum effects occur as special cases. This not only reduces the number of fundamental assumptions but presents a new view of the interrelationship of the different branches of physics. GRA

**N78-31942#** Texas Univ., Austin. Center for Particle Theory.
**LIGHT ON LIGHT: SATYENDRA NATH BOSE'S WORK ON RADIATIVE EQUILIBRIUM**
E. C. G. Sudarshan Jun. 1977 31 p refs
(Contract EY-76-S-05-3992)
(ORO-3992-307) Avail: NTIS HC A03/MF A01

Radiative equilibrium is discussed with emphasis on electromagnetic theory, photons, statistical mechanics of a photon gas, Bose-Einstein statistics, Bose processes as an innovation of a Poisson process, Einstein's dynamic derivation for Bohr atoms, Bose's generalized dynamic derivations, dynamical theory of radiative equilibrium, partial coherence, quantum field theory, and Bose condensation. ERA

# 80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

**N78-31943#** American Council on Education, Washington, D.C. Higher Education Panel.
**INTERNATIONAL SCIENTIFIC ACTIVITIES AT SELECTED INSTITUTIONS, 1975-1976 AND 1976-1977 Final Report**
Frank J. Atelsek and Irene L. Gomberg Jan. 1978 48 p
(Contract NSF C-SRS-77-17251)
(PB-280151/2; HEP-37) Avail: NTIS HC A03/MF A01 CSCL 05I

A survey of 258 institutions that award a medical or doctorate degree is reported. Each institution was asked to indicate, for the 1975-76 and 1976-77 academic years: (1) enrollment of five or more foreign graduate science and engineering students or arragements to send any of its own graduate science students abroad for study; (2) whether any of its science and engineering faculty had taught at a foreign institute, collaborated with foreign researchers or faculty or travelled abroad for research purposes; and (3) any formal teaching or research programs in the sciences dealing with the specified world regions. The primary world regions under study were grouped into the following categories: (1) Western Europe; (2) Latin America and the Caribbean; (3) East Europe and the Soviet Union; (4) the Far East; (5) Japan; (6) South Asia; (7) Black Africa (south of the Sahara); (8) the Near and Middle East and North Africa; and (9) all others. GRA

**N78-31944#** Research Triangle Inst., Research Triangle Park, N. C. Center for Educational Research and Evaluation.
**REPORT OF THE 1977 NATIONAL SURVEY OF SCIENCE, MATHEMATICS, AND SOCIAL STUDIES EDUCATION Final Report**
Iris R. Weiss Mar. 1978 492 p
(Contract NSF C-76-19848)
(PB-280192/6; RTI-1266-06-01F) Avail: NTIS HC A21/MF A01 CSCL 05I

A technical report of a national survey of approximately 10,000 teachers, principals, supervisors is presented. Response rates for the various groups ranged from 72 percent to 90 percent.

Descriptions of sample design, instrument development, data collection, file preparation, and analysis procedures used in the survey as well as results of the study are included. Topics covered relate to: state and local supervision; course offerings; federally-funded curriculum development efforts; textbook usage; instructional materials and techniques; facilities and equipment; teachers' needs for assistance; sources of information; and factors that affect science, mathematics and social studies education. GRA

# 81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**N78-31945#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**SIMULATION OF THE ACQUISITION MANAGEMENT INFORMATION SYSTEM M.S. Thesis**
Alfred H. Linder, III Mar. 1977 131 p refs
(AD-A055209; AFIT/GCS/MA/78-1) Avail: NTIS HC A07/MF A01 CSCL 05/1

The emphasis of this investigation is on the development of a simulation model that will allow an analysis to be performed on the batch-interactive-mix and throughput performance of the IBM 370/155 computer, used by the Acquisition Management Information System (AMIS) users. The basics of hardware and software are discussed, along with some information concerning the System 2000 data base management software package. After the operating characteristics have been discussed, the need for system requirements, definitions and performance measures are presented and the necessary simulation steps are enumerated to show how the simulation model was constructed. The main variables of interest (CPU utilization and gain factor) are analyzed to determine the throughput performance of the system as the interactive workload is increased and as the number of interactive ports are decreased. GRA

**N78-31946#** General Accounting Office, Washington, D. C. Procurement and Systems Acquisition Div.
**STATUS OF THE AIR FORCE'S F-16 AIRCRAFT PROGRAM Report to the Congress**
24 Apr. 1978 48 p refs
(PB-280304/7; PSAD-78-36) Avail: NTIS HC A03/MF A01 CSCL 01C

The Department of Defense approved full production for the F-16 on October 13, 1977. Although sufficient testing was accomplished for the program to enter full production, a number of uncertainties are associated with the program. The uncertainties include F-100 engine problems, an ambitious deployment schedule and support requirements generated by this deployment, subsystem design problems, support of European manufacturers and survivability/vulnerability issues. GAO recommends that the Secretary of Defense require a complete program review before making any commitments for USAF F-16 purchases beyond the first 650 aircraft. This review should include an updated military need assessment and comparison of F-16 performance under realistic operational conditions. GRA

**N78-31947#** National Technical Information Service, Springfield, Va.
**DECISION MAKING IN MANAGEMENT. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1970 - May 1978**
George W. Reimherr Jun. 1978 291 p Supersedes NTIS/PS-77/0580; NTIS/PS-76/0540; NTIS/PS-75/500
(NTIS/PS-78/0605/2; NTIS/PS-77/0580; NTIS/PS-76/0540; NTIS/PS-75/500) Avail: NTIS HC $28.00/MF $28.00 CSCL 05A

Research on decision making is cited. Decision making aids and evaluations of criteria used in decision making are included, as are aids to decision making in various industries research and development, and the military. Decision theoretic models are also covered. GRA

# 82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

**N78-31948** California Univ., Berkeley.
**CONTROL OF ACCESS TO SHARED INFORMATION Ph.D. Thesis**
Theodore David Friedman 1977 119 p
Avail: Univ. Microfilms Order No. 78-12562

The problem of information leakage by software in computer systems is treated by introducing a graph theoretic framework based on the concept of accessibility. Various applications which require control of access are illustrated using this framework. The work of Fenton in the area of memoryless programs and confinement is discussed and generalized. A systematic method to prevent leakage in access control list systems is presented based on confinement of programs. Dissert. Abstr.

**N78-31949#** Telecom, Inc., Vienna, Va.
**BASELINE NATIONAL AIRSPACE DATA INTERCHANGE NETWORK (NADIN) DATA BASE**
Jun. 1976 48 p
(Contract DOT-FA74WA-3264)
(AD-A056112; FAA-RD-76-95) Avail: NTIS HC A03/MF A01 CSCL 01/2

The current Baseline National Airspace Data Interchange Network (NADIN) subscriber data base is described in terms of existing terminal types, population, and circuit configuration for Service B; National, Pacific and Carribbean AFTN. Also, included are current service A weather and request reply subscriber data. G.G.

**N78-31950#** Syracuse Univ., N. Y.
**LARGE SCALE INFORMATION SYSTEMS, VOLUME 1 Final Technical Report, 3 Jun. 1974 - 2 Feb. 1977**
Griffiss AFB, N. Y. RADC Mar. 1978 144 p refs 4 Vol.
(Contract F30602-74-C-0335)
(AD-A054942; RADC-TR-78-43-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 09/2

This report describes and references work conducted by Syracuse University in four broad areas: parallel processing, programming languages, modeling, and performance evaluation of generalized data management systems. A number of applications were evaluated for processing by an associative processor architecture including air traffic control, carryless arithmetic and simulation of high-speed random logic. An extension of the typed lambda calculus has been developed which permits the binding and application of types. User-defined types and procedural data structures are shown to be complementary tools for data abstraction. Direct and continuation semantics of the domain of flow diagrams are formulated and the properties explored. The use of transition diagrams as a tool for structured programming has been investigated. A variety of concepts and notations have been devised to facilitate reasoning about arrays. Work relation to various simulation tasks are reported on. A tutorial on the current statisical methods of analyzing simulation output data is provided. A number of tasks relating to file systems are discussed and a framework is advanced for describing various file organizations and operations on files. Author (GRA)

**N78-31951#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
**REPRESENTING VISUAL INFORMATION**
D. Marr May 1977 64 p refs
(Contract N00014-75-C-0643)
(AD-A055045; AI-M-415) Avail: NTIS HC A04/MF A01 CSCL 06/4

Vision is the construction of efficient symbolic descriptions from images of the world. An important aspect of vision is the choice of representations for the different kinds of information in a visual scene. In the early stages of the analysis of an image, the representations used depend more on what it is possible to compute from an image than on what is ultimately

desirable, but later representations can be more sensitive to the specific needs of recognition. This essay surveys recent work in vision at M.I.T. from a perspective in which the representational problems assume a primary importance. An overall framework is suggested for visual information processing, in which the analysis proceeds through three representations: (1) the primal sketch, which makes explicit the intensity changes and local two-dimensional geometry of an image, (2) the 2 1/2-D sketch, which is a viewer-centered representation of the depth, orientation and discontinuities of the visible surfaces, and (3) the 3-D model representation, which allows an object-centered description of the three-dimensional structure and organization of a viewed shape. Recent results concerning processes for constructing and maintaining these representations are summarized and discussed. Author (GRA)

**N78-31952#** United Technologies Corp., Windsor Locks, Conn. Hamilton Standard Div.
**PRELIMINARY DESIGN OF AN ACCIDENT INFORMATION RETRIEVAL SYSTEM (AIRS) Final Report, Jun. 1976 - Aug. 1977**
Henry R. Ask, Marston E. Moffatt, Ivor Hughes, Larry Brock, and John Bikowski Apr. 1978 277 p refs
(Contract DAAJ02-76-C-0058; DA Proj. 1F2-62209-AH-76)
(AD-A055590; HSER-7342; USARTL-TR-77-51) Avail: NTIS HC A13/MF A01 CSCL 01/2

This report covers the phase 1 activity entitled Concept Investigation and phase 2 entitled Preliminary Design and System Analysis. The report details the analyses involving requirements, parameters, trade-offs, and definition of a recommended AIRS. The Phase 1 effort included the intense analysis of the airborne portion of the system since it is the most sensitive element in terms of size, weight, and cost. This included examination of the parameter and sensor requirements, survivability and software. Actual flight data was used to run a program on a large-scale computer to determine limits, accuracy, and sampling rate effects on flight data reconstruction and aircraft memory storage requirements. Phase 2 included a detailed preliminary design of the AIRS. A preliminary hardware concept was established and the essential features of the recommended concept are included. The recommended system was analyzed to determine performance, weight, size, cost, installation, survivability, reliability, data retrieval, maintenance and functional test factors. Results indicate that the current state of the art will allow an AIRS to be developed for installation on production UTTAS and AAH aircraft. The recommended system employs an all solid-state design including the mass data storage device. Factors of two or more improvements in size, weight, reliability, maintainability are indicated over current data recording systems. Author (GRA)

**N78-31953#** Informatics, Inc., Rockville, Md.
**CURRENT KNOWLEDGE ON NUMERICAL DATA INDEXING AND POSSIBLE FUTURE DEVELOPMENTS Final Report**
Apr. 1978 66 p refs
(Grant NSF DSI-76-17294)
(PB-279924/5) Avail: NTIS HC A04/MF A01 CSCL 05B

A comprehensive review and analysis are given of programs aimed at developing methodologies for indexing the numerical data that occur in the literature used by scientists and engineers. Based on the study results, eleven recommendations are made which focus attention on the principal issues requiring consideration in any future data indexing efforts including the need for improved guidelines for indexes, more cooperative programs, and, ultimately, increased standardization. GRA

# 83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

**N78-31954*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**OUTLINE OF COST-BENEFIT ANALYSIS AND A CASE STUDY**
Abe Kellizy Sep. 1978 28 p refs
(NASA-TM-78984; E-9761) Avail: NTIS HC A03/MF A01 CSCL 05C

The methodology of cost-benefit analysis is reviewed and a case study involving solar cell technology is presented. Emphasis is placed on simplifying the technique in order to permit a technical person not trained in economics to undertake a cost-benefit study comparing alternative approaches to a given problem. The role of economic analysis in management decision making is discussed. In simplifying the methodology it was necessary to restrict the scope and applicability of this report. Additional considerations and constraints are outlined. Examples are worked out to demonstrate the principles. A computer program which performs the computational aspects appears in the appendix. L.S.

**N78-31955#** Chicago Univ., Ill. Dept. of Economics.
**SOCIAL OPPORTUNITY COST OF CAPITAL: EMPIRICAL ESTIMATES**
S. Townsend Feb. 1978 37 p refs
(Contract W-31-109-eng-38)
(ANL-SPG-2) Avail: NTIS HC A03/MF A01

Estimates of the social-opportunity cost of public capital are developed. The private and social costs of capital are found to diverge primarily because of the effects of corporate and personal income taxes. In the absence of specific information about each project, the use of the economy-wide average default and risk adjustments is suggested. These are included in the empirical estimates reported. International capital markets make available private capital, the price of which is not distorted by the U.S. tax system. The inclusion of foreign sources slightly reduces the social-opportunity cost of capital. ERA

# 84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

**N78-31956#** Committee on Appropriations (U. S. Senate).
**DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, AND CERTAIN INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1979, PART 2**
Washington GPO 1978 1142 p refs Hearings on H.R. 12936 before a subcomm. of the Comm. on Appropriations, 95th Congr., 2d Sess., 13 Apr. 1978
(GPO-23-600) Avail: SOD HC

The Department of Housing and Urban Development's fiscal year 1979 budget request as well as two relatively minor fiscal 1978 supplements are discussed. Testimony is also presented regarding the fiscal 1979 budget request for the National Aeronautics and Space Administration. Budget request for the Selective Service System and the National Institute of Building Sciences are also discussed. G.Y.

**N78-31957#** Department of Energy, Washington, D. C.
**PRELIMINARY FINDINGS AND VIEWS CONCERNING THE EXEMPTION OF AVIATION GASOLINE FROM THE MANDATORY PETROLEUM ALLOCATION AND PRICE REGULATIONS**
Jan. 1978 84 p
(DOE/ERA-0001) Avail: NTIS HC A05/MF A01

Preliminary findings indicated that: the fuel is not in short supply; exemption will not have an adverse impact on supply of any other petroleum product subject to the Emergency Petroleum allocation Act of 1973; competition and market force are adequate; exemption will not result in inequitable prices; and exemption will not have adverse state or regional impacts or any other adverse impacts. Background information on the use, production, and distribution of aviation gasoline is provided. The historical interaction of supply, demand and price is analyzed. The market structure for aviation gasoline during 1968 to 1976, prior to and during imposition of allocation and price controls is explored. Aviation gasoline supply, demand price, and market structure impacts of exempting aviation gasoline from controls is examined. The potential economic impacts of exemption are evaluated. A final summary of the DOE's findings and views in support of its preliminary judgment that aviation gasoline should

be exempted from allocation and price regulations is provided. ERA

**N78-31958#** Department of Energy, Washington, D. C. Energy Information Administration.
**PRELIMINARY FINDINGS AND VIEWS CONCERNING THE EXEMPTION OF KEROJET FUELS FROM THE MANDATORY PETROLEUM ALLOCATION AND PRICE REGULATIONS**
Jan. 1978 109 p
(DOE/ERA-0002) Avail: NTIS HC A06/MF A01

Preliminary findings indicated the following: kerojet fuel is not in short supply; it will not adversely impact on the supply of other petroleum products subject to the Emergency Petroleum Allocation Act; competition and market forces are adequate; and it will not result in inequitable prices for kerojet or other products. Background information on the use, production, and distribution of kerojet is provided. The historical interaction of supply, demand, and price is provided. The market structure for kerojet during 1968 to 1976, prior to and during imposition of allocation and price controls is explored. The effect upon kerojet supply, demand, price, and market structure of exempting kerojet from controls is examined. The benefits derived from such exemption is indicated. The potential economic impacts of exemption are evaluated. A final summary of the DOE's findings and views in support of its preliminary judgment that kerojet should be exempted from allocation and price regulations is provided. ERA

**N78-31959#** National Technical Information Service, Springfield, Va.
**COPYRIGHTS. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - May 1978**
Mary E. Young Jun. 1978 104 p Supersedes NTIS/PS-77/0422, NTIS/PS-76/0304, and NTIS/PS-75/146
(NTIS/PS-78/0529/4; NTIS/PS-77/0422; NTIS/PS-76/0304; NTIS/PS-75/146) Avail: NTIS HC $28.00/MF $28.00 CSCL 05B

Information on national and international copyrights is reviewed in the reports cited. Citations on the problems of copyrighted materials in computer data bases and of photocopying are included. (This updated bibliography contains 98 abstracts, 14 of which are new entries to the previous edition.) GRA

# 85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

**N78-31960*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SOME PROBLEMS OF MARYLAND TOWNS AS SEEN BY THEIR MAYORS**
H. J. Peake Aug. 1978 10 p refs Submitted for publication
(NASA-TM-79618) Avail: NTIS HC A02/MF A01 CSCL 05A

Conversations were held with the mayors of six Maryland towns to discuss possible models and needs for technology transfer. An unexpected outcome of the discussions was a considerable insight into local problems as perceived by the mayors. Problems, whether administrative, socio-economic, or technological, are different, from town to town, in degree, not in kind. Recognition of this feature of local priorities is vital to any considerations of external assistance. L.S.

**N78-31961#** Mitre Corp., McLean, Va. METREX Div.
**TLV (TRACKED LEVITATED VEHICLE) STATUS REPORT Progress Report, 1965 - Jul. 1977**
Roger Katz Oct. 1977 156 p refs
(Contract DOT-FR-54090)
(PB-279845/2; MTR-7599) Avail: NTIS HC A08/MF A01 CSCL 13F

The worldwide status of Tracked Levitated Vehicle (TLV) technology and an assessment of its development is presented. Various maglev and air cushion suspension test facilities in use throughout the world are described. Worldwide research efforts are placed in perspective as they address the outstanding technical problems as a whole. This report uses the SI (metric) units.GRA

**N78-31962#** Hittman Associates, Inc., Columbia, Md.
**OPERATION BREAKTHROUGH SITE MANAGEMENT SYSTEMS AND PNEUMATIC TRASH COLLECTION, EXECUTIVE SUMMARY Final Report**
Jack Preston Overman, Terry G. Statt, and David A. Kolman Feb. 1978 40 p
(Contract EPA-68-03-0094)
(PB-280143/9; EPA-600/8-78-001) Avail: NTIS HC A03/MF A01 CSCL 13B

Waste collection systems within buildings, complexes, and municipalities were analyzed and compared as to economics, effectiveness, environmental factors, efficiency of operation, and acceptance by residents. Eight of the sites used various trash collection methods ranging from conventional curbside pickup to centralized compaction and pickup. The ninth site used a pneumatic trash collection (PTC) system. Evaluation of the refuse management system at the site is summarized particularly the PTC system and the refuse system user acceptance surveys at eight of the nine sites. GRA

**N78-31963#** Maryland Univ., College Park. Fire Protection Curriculum.
**A STATISTICAL SAMPLING OF CITIES: CURRENT AND PROJECTED INVOLVEMENT IN FIRE PREVENTION AND CONTROL MASTER PLANNING Final Report**
John C. Fannin, III 8 Dec. 1977 100 p refs
(Contract NFPCA-7-35563)
(PB-279922/9) Avail: NTIS HC A05/MF A01 CSCL 13B

Of the one hundred thirty-seven cities and communities identified as recipients of the National Fire Prevention and Control Administration's urban guide for fire prevention, control and management planning, seventy-three responded to a survey conducted to ascertain current and future involvement in fire master planning. Based on utilization of the urban guide a comparative analysis of population, incorporation, form of government, and type of fire department, by those cities and communities reporting current involvement in a master planning program is included. The relationships, if any between these characteristics and master planning involvement are discussed. GRA

**N78-31964#** Illinois Inst. for Environmental Quality, Chicago.
**COST OF SOLID WASTE MANAGEMENT IN NORTHEAST ILLINOIS**
Michael Friedman Dec. 1977 53 p
(PB-280562/0; IIEQ-77/37) Avail: NTIS HC A04/MF A01 CSCL 13B

The completed survey, accomplished from July through September, 1976, covered 255 municipalities in the six-county Chicago metropolitan area, with a combined population of approximately 3.3 million. It assigned communities to one of four classifications depending on the type of service available in each. These categories are the following: municipal collection; contract collection; franchise collection; and private collection. GRA

**N78-31965#** Hittman Associates, Inc., Columbia, Md.
**EVALUATION OF THE REFUSE MANAGEMENT SYSTEM AT THE JERSEY CITY OPERATION BREAKTHROUGH SITE Final Report**
Jack Preston Overman and Terry G. Statt Feb. 1978 240 p
(Contract EPA-68-03-0094)
(PB-280551/3; EPA-600/2-78-017) Avail: NTIS HC A11/MF A01 CSCL 13B

The solid waste management system at the Jersey City Operation Breakthrough site was evaluated. The economic and technical practicality fo the system application for future residential complexes was assessed. The installation was the first pneumatic trash collection system (PTC) used to collect residential refuse in the U.S. Labor costs, rodents and vermin, odor, litter, and collection noise are described. The cost and operation are also

coupled of the PTC system with those aspects of conventional collection systems. GRA

**N78-31966#** Maine Univ. at Orono. Land and Water Resources Inst.
**RESEARCH NEEDS RELATING TO ON-SITE TREATMENT OF DOMESTIC WASTES: SUMMARY OF WORKSHOP**
Apr. 1978 18 p Workshop held at Orono, Maine, 10-11 Aug. 1977 Sponsored in part by Northeast Water Inst. Directors and New England Councils of Water Center Directors
(Contract DI-14-31-0001-3953)
(PB-280989/5; W78-06807; OWRT-B-061-RI(4)) Avail: NTIS HC A02/MF A01 CSCL 13B

The use of private on-site sewage systems has accompanied the dispersal of urban populations in the U.S. into rural areas outside older cities and towns. The workshop identified research needs with respect to on-site sewage disposal. Principal suggestions made during and following the workshop are summarized. Areas in which knowledge should be expanded are outlined. Intended to be a step toward a comprehensive regional research program, the report is in two parts: an outline of topic areas/problems/research needs; and elaborations upon principal research needs. GRA

**N78-31967#** National Council of the Paper Industry for Air and Stream Improvement, Inc., Kalamazoo, Mich. Central-Lake States Regional Center.
**PILOT INVESTIGATION OF SECONDARY SLUDGE DEWATERING ALTERNATIVES Final Report, 1 Nov. 1975 - 31 Oct. 1976**
Reid A. Miner, Duane W. Marshall, and Isaiah Gellman Feb. 1978 127 p refs
(Contract EPA-R-804019-01-0)
(PB-280982/0; EPA-600/2-78-014) Avail: NTIS HC A07/MF A01 CSCL 13B

Biological sludge thickening and dewatering alternatives, including pressure filtration, precoat vacuum filtration, fiber belt pressing, capillary suction, dewatering, gravity filtration, centrifugation and ultrafiltration was investigated on waste activated sludge resulting from the treatment of wastewater from an integrated bleached kraftfine paper mill. Based upon a criterion of attainable cake consistency, three levels of performance are indicated: (1) pressure filtration and precoat vacuum filtration generating the driest cakes, (2)filter belt pressing yielding intermediate cake consistencies, and (3)gravity filtration, centrifugation, and ultrafiltration resulting in relatively low cake consistencies. Performance was severely affected by changes in feed sludge consistency, the amount of sludge conditioning, and the sludge's specific conditioning, and the sludge's specific resistance to filtration. The type and amount of sludge conditioning required was extremely variable, depending upon the dewatering technique employed, the level of performance expected of it, and the consistency and nature of the sludge dewatered. GRA

**N78-31968#** Auburn Univ., Ala. Water Resources Research Inst.
**EFFECTS OF WATER-TREATMENT-PLANT WASTES ON DOMESTIC WASTEWATER TREATMENT PROCESSES Final Report**
Joe Miller Morgan, Brian Alan Rindt, John Richard Voorhees, and Malcolm Earl Burman Jul. 1977 116 p refs
(PB-280970/5; WRRI-Bull-28; W78-06811; OWRT-A-040-ALA(1)) Avail: NTIS HC A06/MF A01 CSCL 13B

The impact of alum-water-treatment-plant sludge on primary clarification, anaerobic sludge digestion, activated sludge wastewater treatment, and the dewatering of various sludges were investigated. Results indicated that few ill effects would result from disposal of alum sludges in this manner, and that under certain conditions the performance of the wastewater treatment plant might be enhanced. The only potentially serious adverse effect was that the total volume of sludge to be treated and disposed of at the wastewater treatment plant would increase somewhat. GRA

**N78-31969#** General Accounting Office, Washington, D. C. Community and Economic Development Div.
**SECONDARY TREATMENT OF MUNICIPAL WASTEWATER IN THE ST. LOUIS AREA - MINIMAL IMPACT EXPECTED**
12 May 1978 65 p
(PB-280965/5; CED-78-76) Avail: NTIS HC A04/MF A01 CSCL 13B

The planned expenditures are pointed out of Federal funds for secondary treatment works in the St. Louis, Missouri, area will only minimally improve the quality of water in the Mississippi River. A study to determine what impact water pollution control activities near St. Louis would have on water quality and what additional benefits could be expected is reviewed. Congress is therefore recommended to amend the law to eliminate the mandatory requirement for secondary treatment of discharges to fresh water when dischargers can demonstrate that the environmental impact of secondary treatment will be minimal or insignificant. GRA

**N78-31970#** Florida Univ., Gainesville.
**CYPRESS WETLANDS FOR WATER MANAGEMENT, RECYCLING AND CONSERVATION Final Annual Report, 16 Dec. 1976 - 15 Dec. 1977**
Howard T. Odum and Katherine C. Ewel Mar. 1978 953 p refs
(Grants NSF ENV-77-06013)
(PB-282159/3; NSF/RA-780061; AR-4) Avail: NTIS HC A99/MF A01 CSCL 13B

Recycling of treated sewage wastewaters into two cypress domes in Gainesville, Florida is described. The cypress swamps through the shielding effect of their thin leaf cover and their leaf drop in dry season save water, as compared to open water storage. A cypress strand at Waldo receiving sewage for 43 years showed the long-term stability of the ecosystem receiving the nutrients. Drawdown of superficial groundwaters was found to occur a half mile from canals in south Florida. Lowering the water tables reduced the productivitity and temporarily reduced transpiration. Evaluations showed that cypress swamp substitution for technological tertiary treatment was feasible. GRA

# 88 SPACE SCIENCES (GENERAL)

**N78-31971*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GAMMA RAY SPECTROSCOPY IN ASTROPHYSICS**
T. L. Cline, ed. and R. Ramaty, ed. Aug. 1978 598 p refs Symp. held at Greenbelt, Md., 28-29 Apr. 1978
(NASA-TM-79619) Avail: NTIS HC A25/MF A01 CSCL 03B

Experimental and theoretical aspects of gamma ray spectroscopy in high energy astrophysics are discussed. Line spectra from solar, stellar, planetary, and cosmic gamma rays are examined as well as HEAO investigations, the prospects of a gamma ray observatory, and follow-on X-ray experiments in space. For individual titles, see N78-31972 through N78-32013.

**N78-31972*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MECHANISMS AND SITES FOR ASTROPHYSICAL GAMMA RAY LINE PRODUCTION c93**
R. Ramaty *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 7-41 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

The production of gamma ray lines and estimates of line fluxes resulting from nuclear deexcitations, positron annihilation, and electron capture at various astrophyical sites are discussed. Supernova and nova explosions synthesize long-lived radioactive isotopes and eject them into space where they produce observable gamma ray lines by decaying into excited levels of daughter nuclei or by emitting positrons. Energetic charged particles in the interstellar medium, in supernova remants, in solar or stellar flares, and possibly in the vicinity of compact objects, produce gamma-ray lines by inelastic collisions which either excite nuclear levels or produce positrons and neutrons. Energetic particles can result from acceleration in time-varying magnetic fields (solar flares) or from gravitational accretion onto neutron stars and black holes. Electromagnetic processes in the strong magnetic

fields of pulsars can produce positron-electron pairs, with line emission resulting from positron annihilation. Deexcitations of quantized states in strong magnetic fields can also produce lines. A.R.H.

**N78-31973*#** New Hampshire Univ., Durham. Dept. of Physics.
**GAMMA RAY SPECTROSCOPY IN ASTROPHYSICS: AN OBSERVATIONAL OVERVIEW (50 keV-20 MeV) c90**
E. L. Chupp *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 42-68 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

The observational status of gamma ray astronomy based on results reported prior to April 1978 is discussed. Specific line observations are reviewed from the Sun, the galactic plane, the Galactic Center region, the active Galaxy NGC 5128 (Cen A), the Crab Nebula region, and a transient source in the general direction of the anti-Galactic Center region. A statistical method is described which determines the relative probability that a given, reported observation is due to an external source as compared to a random fluctuation in the experimental background counting rate. Only a few of the many reported observations can be considered likely extraterrestrial observations of an extraterrestrial source made with a confidence level of 99%. A.R.H.

**N78-31974*#** Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
**A HARD X-RAY AND GAMMA RAY OBSERVATION OF THE 22 NOVEMBER 1977 SOLAR FLARE c92**
G. Chambon, K. Hurley, M. Niel, R. Talon, G. Vedrenne, O. B. Likine (IKI, Moscow), A. V. Kouznetsov (IKI, Moscow), and I. V. Estouline (IKI, Moscow) *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 70-75 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

The Franco-Soviet experiment package Signe 2 MP for solar and cosmic X and gamma ray observations, launched aboard a Soviet Prognoz satellite into a highly eccentric earth orbit is described. An uncollimated NaI detector 37 mm thick by 90 mm diameter, placed on the upper surface of the satellite faced the sun. A collimated lateral NaI detector 14 mm thick by 38 mm diameter also faced the sun, and a similar lateral detector faced the anti-solar direction. Data tapes reveal an intense solar flare up to energies of up to 5 MeV, with evidence for line emission at 2.23 MeV and possibly 4.4 MeV. The event observed was associated with the Mc Math Plage Region 15031, and an H-alpha flare of importance 2B. It is not yet clear what radio emission is associated with the X-ray observation. A.R.H.

**N78-31975*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GAMMA RAY EMISSION AND SOLAR FLARES**
R. P. Lin (California Univ., Berkeley) and R. Ramaty *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 76-96 refs (For primary document see N78-31971 22-92)
(Grant NGL-05-003-017)
Avail: NTIS HC A25/MF A01 CSCL 03B

Solar gamma ray line and continuum emission provide information about particle acceleration and its temporal behavior; the energy spectrum, composition and directivity of the accelerated particles; and the composition, density and temperatures of the ambient medium. These data, coupled with the comprehensive photon and particle observations available for the sun, give a detailed picture of the particle acceleration and flare energy release processes. Additional information on elemental and isotopic abundances, surface nuclear reactions and coronal heating mechanisms can be obtained. Implications of present observations and the potential return from future observational are discussed. A.R.H.

**N78-31976*#** Los Alamos Scientific Lab., N. Mex.
**PLANETARY GAMMA-RAY SPECTROSCOPY c93**
Robert C. Reedy *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 98-148 refs Sponsored in part by NASA and DOE (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

The measured intensities of certain gamma rays of specific energies escaping from a planetary surface can be used to determine the abundances of a number of elements. The fluxes of the more intense gamma-ray lines emitted from 32 elements were calculated using current nuclear data and existing models for the source processes. The source strengths for neutron-capture reactions were modified from those previously used. The fluxes emitted form a surface of average lunar composition are reported for 292 gamma-ray lines. These theoretical fluxes were used elsewhere to convert the data from the Apollo gamma-ray spectrometers to elemental abundances and can be used with measurements from future missions to map the concentrations of a number of elements over a planet's surface. Detection sensitivities for these elements are examined and applications of gamma-ray spectroscopy for future orbiters to Mars and other solar-system objects are discussed. A.R.H.

**N78-31977*#** Los Alamos Scientific Lab., N. Mex.
**NUCLEAR GAMMA RAYS FROM STELLAR FLARES c93**
Stirling A. Colgate *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 149-167 refs Sponsored in part by NASA, DOE, and the Aspen Inst. of Physics (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

Solar flare observations are consistent with the phenomenological description that a loop of magnetic flux is convected to the surface of the star and twisted. The resulting inductive current parallel to the field is dissipated at an enhanced rate throughout the field volume by current limiting instabilities. The steady state balance between joule heating and thermal conduction along the field lines of force to the denser, cooler surface establishes a temperature distribution. The expansion of heated and ionized surface layers leads to a pressure balance and hence predictable density and X-ray emission measure. The current limitation instabilities result observationally in the parallel current being transferred to run-away ions that reach a kinetic energy of some finite fraction of the inductive potential drop. The nuclear excitation gamma rays produced by such a run-away ion current are calculated for a white dwarf flare. A.R.H.

**N78-31978*#** Bell Telephone Labs., Inc., Murray Hill, N. J.
**DETECTION OF 511 keV POSITRON ANNIHILATION RADIATION FROM THE GALACTIC CENTER DIRECTION c93**
M. Leventhal, C. J. MacCallum, and P. D. Stang *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 169-189 refs Sponsored by ERDA. Prepared in cooperation with Sandia Labs., Albuquerque, N. Mex. (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

A balloon-borne gamma ray telescope with an approximately 130 cu cm high purity germanium detector was flown over Australia to detect sharp spectral features from the galactic center direction. A 511 keV positron annihilation line was observed at a flux level of (1.21 plus or minus 0.22) x (10/cu cm) photons/sec/sp cm. Suggestive evidence for the detection of the three-photon positronium continuum is presented. The possible origin of the positrons is discussed. A.R.H.

**N78-31979*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE GALACTIC GAMMA-RAY FLUX IN THE 0.06 TO 5 MeV RANGE c93**
D. Gilman (JPL), A. E. Metzger (JPL), R. H. Parker (JPL), and J. I. Trombka *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 190-206 refs (For primary document see N78-31971 22-88)
(Contract NAS7-100)
Avail: NTIS HC A25/MF A01 CSCL 03B

Gamma ray emission from the longitude range -50 deg less than or equal to lambda less than or equal to 22 deg recorded by the Apollo gamma-ray spectrometer and by individual observers is discussed. Agreement of the galactic emission spectra near 1 MeV with hard X-ray observations of the galactic central regions suggests that an ensemble of point sources is responsible for the emissions. Apollo 16 upper limits to the cosmic 4.4 MeV line flux imply that the ratio of line strength to continuum emission

for the region observed by Haymes et al is higher than the galactic average. A.R.H.

**N78-31980*#** Max-Planck-Institut fuer Physik und Astrophysik, Garching (West Germany).
**LOW ENERGY GAMMA RAY OBSERVATIONS WITH THE MPI-COMPTON TELESCOPE** **c93**
F. Graml, F.-P. Penningsfeld, and V. Schoenfelder *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 207-216 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

Although the evaluation of data from the first balloon-flight of a large area Compton telescope is incomplete, two preliminary results are discussed. From the measured background spectrum at float altitude, the sensitivity of the telescope for the detection of cosmic gamma ray lines is estimated. The energy spectra is determined for an enhancdd gamma ray flux observed from the direction of the Seyfert galaxy NGC 4151. A schematic drawing of the telescope is presented and discussed. A.R.H.

**N78-31981*#** California Univ., Riverside. Dept. of Physics.
**SEARCH FOR BROAD GAMMA RAY LINES WITH THE UCR DOUBLE COMPTON SCATTER TELESCOPE** **c93**
R. Stephen White, James M. Ryan, Robert B. Wilson, Allen D. Zych, and Bruce Dayton (California State Univ., Los Angeles) *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 217-222 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

The operation of a double scatter telescope and the evaluation of data obtained during a 24 hour balloon flight are discussed. An increase in gamma rays was observed as the galactic anti-center crossed the aperature of the telescope. Searches for lines from p(n,gamma)d at 2.2 MeV, C-12* at 4.4 MeV and on -16* at 6.1 MeV and for other lines broadened or redshifted are being conducted to identify the processes responsible for the production of celestial gamma rays. Two upper limits for lines in the angalactic anti-center direction at 4.4 MeV and 6.1 MeV are 6 and 4 x 10 to the minus 4 power gamma/sq cm-s. A.R.H.

**N78-31982*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**RICE UNIVERSITY OBSERVATIONS OF THE GALACTIC CENTER** **c89**
Charles A. Meegan *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 223-227 refs (For primary document see N78-31971 22-90)
Avail: NTIS HC A25/MF A01 CSCL 03A

The most sensitive of the four balloon fight observations of the galactic center made by Rice University was conducted in 1974 from Rio Cuarto, Argentina at a float altitude of 4 mbar. The count rate spectrum of the observed background and the energy spectrum of the galactic center region are discussed. The detector used consists of a 6 inch NaI(T 1ambda) central detector collimated to approximately 15 deg FWHM by a NaI(T lamdba) anticoincidence shield. The shield in at least two interaction mean free paths thick at all gamma ray energies. The instrumental resolution is approximately 11% FWHM at 662 keV. Pulses from the central detector are analyzed by two 256 channel PHA's covering the energy range approximately 20 keV to approximately 12 MeV. The detector is equatorially mounted and pointed by command from the ground. Observations are made by measuring source and background alternately for 10 minute periods. Background is measured by rotating the detector 180 deg about the azimuthal axis. A.R.H.

**N78-31983*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**OBSERVATIONAL EVIDENCE FOR EXTRATERRESTRIAL GAMMA-RAY LINE SOURCES** **c93**
A. S. Jacobson, J. C. Ling, W. A. Mahoney, and J. B. Willett *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 228-251 refs (For primary document see N78-31971 22-88)
(Contract NAS7-100)
Avail: NTIS HC A25/MF A01 CSCL 03B

During the 1974 balloon flight of a high spectral resolution gamma-ray telescope, observing in the energy range of about 50 keV to 10 Mev, evidences were gathered for two cosmic sources of gamma-ray lines. These are a 73 keV line feature superimposed on a power law continuum spectrum in the 55 to 300 keV range from the Crab nebula; and a flare-like event lasting about twenty minutes, during which four intense gamma-ray lines were measured at .41, 1.79, 2.22 and 5.95 MeV. The properties and operation of the detector used are described. The measured spectrum and count rate are discussed. A.R.H.

**N78-31984*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**NUCLEAR GAMMA RAYS FROM COMPACT OBJECTS** **c93**
R. E. Lingenfelter (California Univ., Los Angeles), J. C. Higdon (Arizona Univ., Tucson), and R. Ramaty *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 252-274 refs (For primary document see N78-31971 22-88)
(Grants NsG-7101; NSF AST-76-08178)
Avail: NTIS HC A25/MF A01 CSCL 03B

Accreting compact objects may be important gamma ray line sources and may explain recent observations of celestial gamma-ray line emission from a transient source in the direction of the galactic anti-center, from the galactic center, and possibly from the radio galaxy Centaurus A. The identification of the lines from the transient source requires a strong redshift. Such a redshift permits the identification of these lines with the most intense nuclear emission lines expected in nature, positron annihilation, and neutron capture on hydrogen and iron. Their production as a result of nuclear interactions in accreting gas around a neutron star is proposed. The gamma-ray line emission from the galacuic center and possibly Centaurus A appears to have a surprisingly high luminosity, amounting to perhaps as much as 10% of the total luminosity of these sources. Such high gamma-ray line emission efficiencies could result from nuclear interactions in accreting gas around a massive black hole. A.R.H.

**N78-31985*#** Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
**GAMMA-RAY LINES FROM NEUTRON STARS AS PROBES OF FUNDAMENTAL PHYSICS** **c93**
Kenneth Brecher *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 275-282 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

The detection of gamma-ray lines produced at the surface of neutron stars will serve to test both the strong and gravitational interactions under conditions unavailable in terrestrial laboratories. Observation of a single redshifted gamma-ray line, combined with an estimate of the mass of the star will serve as a strong constraint on allowable equations of state of matter at supernuclear densities. Detection of two redshifted lines arising from different physical processes at the neutron star surface can provide a test of the strong principle of equivalence. Expected fluxes of nuclear gamma-ray lines from accreting neutron stars were calculated, including threshold, radiative transfer and redshift effects. The most promising probes of neutron star structure are the deuterium formation line and the positron annihilation line. Detection of sharp redshifted gamma-ray lines from X-ray sources such as Cyg X-1 would argue strongly in favor of a neutron star rather than black hole identification for the object. Author

**N78-31986*#** Commissariat a l'Energie Atomique, Saclay (France).
**GAMMA RAY ASTRONOMY AND THE ORIGIN OF THE LIGHT NUCLEI** **c89**
Hubert Reeves *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 283-301 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03A

Nuclear reactions induced by the collisions of the protons and alphas of the galactic cosmic ray with heavy nuclei of the interstellar gas are responsible for the continuous production of the light elements lithium, beryllium, and boron in the galaxy. To better than one order of magnitude, the observed ratios of these abundances to hydrogen abundance and the nuclidic abundance ratios between themselves are accounted for by simply considering the effect of fast protons and alphas with a

flux and an energy spectrum as observed in galactic cosmic rays, for a period comparable with the life of our galaxy. The role of gamma ray astronomy in solving problems that occur when accurate agreement is souught with increasingly accurate data is discussed. A.R.H.

**N78-31987*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GALACTIC CENTER IRON LINE EMISSION c93**
D. M. Worrall, E. A. Boldt, S. S. Holt, S. H. Pravdo, and P. J. Serlemitsos *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 302-309 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

Data from the Goddard Space Flight Center experiment on HEAO 1 were examined for galactic center iron line emission. Evidence for a 6.8 keV line from the summed flux within 10 deg longitude and 10 deg latitude of the galactic center was found; however, firm limits cannot be put on the intrinsic line width. If the line emission is diffuse and cosmic-ray-induced, the calculations of Bussard et al (1978) yield an upper limit to c-12 4.44 MeV line emission, which is not inconsistent with the results of Haymes et al (1975). Significant contributions to the iron line from discrete sources can not be ruled out. A.R.H.

**N78-31988*#** Chicago Univ., Ill.
**GAMMA LINE RADIATION FROM SUPERNOVAE c93**
W. D. Arnett *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 310-314 refs (For primary document see N78-31971 22-88)
(Grant NSF 76-20253)
Avail: NTIS HC A25/MF A01 CSCL 03B

Recent calculations of core collapse or massive stars result in explosive ejection of the mantle by a reflected shock. These hydrodynamic results are important for predictions of explosive nucleosynthesis and gamma-ray line emission from supernovae. Previous estimates, based on simple parameterized models or the nucleosynthesis in an average supernova, are compared with these latest results. A.R.H.

**N78-31989*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GAMMA RAY LINES FROM NOVAE c93**
James W. Truran (Illinois Univ.), Sumner G. Starrfield (Arizona State Univ.), and Warren M. Sparks *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 315-322 refs (For primary document see N78-31971 22-88)
(Grants NSF AST-76-22673; NSF AST-77-23190)
Avail: NTIS HC A25/MF A01 CSCL 03B

Activities identify the mechanisms responsible for the eruptions characterizing cataclysmic variables are concerned with close binary systems, the properties of which are dominated by the presence of mass transfer from a late-type star onto a white dwarf via an accretion disk. Theories for the outbursts vary in their identification of the eruption mechanism with either gravitational or nuclear energy sources. Existing models for the dwarf novae invoke a dynamical instability in the envelope of the red star which triggers episodic Roche lobe overflow and a concomitant increase in the rate of mass transfer and the outbursts are associated with an increase in the accretion luminosity liberated in the disk. The most successful theoretical models for common nova events involve thermonuclear runaways proceeding in accreted hydrogen envelopes on the white dwarf components of these systems. The characteristics of such runaway events, which can give rise to detectable gamma ray fluxes are discussed. Salient features of existing runaway models are reviewed. Gamma fluxes from Na-22 decay, positron annihilation, and shock induction are predicted. A.R.H.

**N78-31990*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GAMMA-RAY LINE EMISSION ABOVE 8 MeV c93**
C. J. Crannell and H. Crannell (Catholic Univ. of Am.) *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 323-329 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

The spectra of energetic nuclei within astrophysical sources may be determined by studying gamma-ray line emissions above 8 MeV. Excited states which can be produced by inelastic scattering, charge exchange, and spallation reactions in the abundant nuclear species were considered in order to identify nuclear lines which may contribute to the gamma spectrum. The cross sections for production of most high-energy states are sparsely measured. Those which were determined are comparable to the cross section for production of the 15.11 MeV level in C-12 with few exceptions. The branching ratios for gamma-ray and particle emission are, however, better known. Of those states considered, 44 measured branching ratios greater than 40% for emission of a gamma-ray with energy above 8 MeV. For twelve more states the branching ratios, although not yet determined, are expected to be small. The gamma-ray emission from other individual nuclear states is not likely to be as great as that that for the 15.11 MeV state in C-12. A.R.H.

**N78-31991*#** Max-Planck-Institut fuer Physik und Astrophysik, Garching (West Germany).
**CYCLOTRON LINES FROM Her X-1 c93**
J. Truemper *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 331-345 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

Data obtained during four balloon flight observations of hard X-ray emission from Her X-1 provide strong support for the existence of a spectral line feature at 54 keV to 58 keV, while the existence of a second harmonic is uncomfirmed. Because it is difficult to explain the observed feature by a second continuum spectrum or by atomic or nuclear processes, an interpretation in terms of a cyclotron line seems likely. There are two possibilities. There may be a cyclotron absorption feature at approximately 42 keV, and a possible second one at approximately 80 keV. In particular there may be a rather broad absorption feature between the spectral break (25 keV) and approximately 40 keV. A.R.H.

**N78-31992*#** Commissariat a l'Energie Atomique, Saclay (France).
**CONFIDENCE ABOUT LINE FEATURES IN Her X-1 SPECTRUM c93**
Ph. Durouchoux, D. Boclet, and R. Rocchia *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 346-370 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

A balloon borne X-ray telescope was flown Aire-surl'Adour, France to search for pulsation of the X-ray source HER X1. The source was measured for about 3500 s relative exposure larger than 0.75 and features were detected at 57.5 plus or minus 7.5 keV and 135 plus or minus 10 keV in the spectrum. Data were reanalyzed in terms of possibility of gain shift encoder. The very strong dependence of the line features on such a shift is discussed. A.R.H.

**N78-31993*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**UPPER LIMITS ON THE CYCLOTRON LINES FROM Her X-1 AS OBSERVED WITH OSO-8 c93**
B. R. Dennis, G. S. Maurer (Catholic Univ. of Am., Washington, D. C.), E. P. Cutler (Comtech, Lanham, Md.), C. J. Crannell, J. F. Dolan, K. J. Frost, and L. E. Orwig *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 371-385 refs (For primary document see N78-31971 22-88)
(Contract NAS5-24451; Grant NsG-5066)
Avail: NTIS HC A25/MF A01 CSCL 03B

Observations of Her X-1 were obtained during its ON-state in September, 1977, with the high-energy X-ray detector on board OSO-8. Upper limits on the line fluxes at 60 and 135 keV based on these observations are above, and hence consistent with, the positive results reported by Trumper, et al from a balloon flight during the same time interval. A detailed analysis of the time-variable et al background spectrum suggests that the line emission, especially in the time-averaged spectrum of Her X-1 previously reported by other workerrs at 25, 60, and 135 keV, is due to instrumental effects. The spectrum obtained with OSO-8 in September, 1977, is considerably steeper than that observed in pre-1976 balloon flights. These results are consistent with the results obtained by Trumper showing a

decrease in the effective temperature of Her X-1 between May, 1976, and September, 1977. A.R.H.

**N78-31994*#** California Univ., San Diego. Dept. of Physics.
**HEAO-1 OBSERVATIONS OF Her X-1 AT ENERGIES ABOVE 13 keV** **c93**
J. L. Matteson, D. E. Gruber, and J. A. Hoffman *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 386-393 Prepared in cooperation with Massachusetts Inst. of Technology (For primary document see N78-31971 22-88)
(Contract NAS8-27974)
Avail: NTIS HC A25/MF A01 CSCL 03B

Results from preliminary analysis of HEAO-1 pointing observations of Her X-1 on three days in February 1978 are presented. Pulsed flux is detected up to approximately 70 keV with a clear indication of emission at approximately 60 deV which is above the continuum spectrum extrapolated from lower energies. If this excess emission is interpreted as a spectral line, its intensity varies from (1.2 plus or minus 0.2) x (10 to the minus 3 power) to (0.2 plus or minus 0.2) x (10 to the minus 3 power) ph/sq cm-sec with a time scale of one day. A factor 2 decrease in the low energy continuum is associated with the decrease in the excess emission. Author

**N78-31995*#** Daugherty (J. K.), Durham, N. C.
**CYCLOTRON EMISSION IN NEUTRON STAR MAGNETOSPHERES** **c93**
J. K. Daugherty *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 394-403 (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

Kinematic aspects of cyclotron emission in superstrong magnetic fields are reviewed to suggest characteristic features which might be useful in confirming the nature of the reported line feature near 50 keV in the spectrum of Her X-1. The role of the inverse process of cyclotron absorption is also discussed. Author

**N78-31996*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE EXCITATION OF ELECTRONIC TRANSVERSE ENERGY LEVELS IN AN INTENSE MAGNETIC FIELD** **c93**
Roger W. Bussard *In its* Gamma Ray Spectry. In Astrophys. Aug. 1978 p 404-417 (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

Observations of the X-ray pulsar Hercules X-1 show a line emission feature at about 60 keV, which has been interpreted as the fundamental electron cyclotron line in a magnetic field of around six trillion gauss. In this interpretation, the line radiation results from transitions between transverse energy levels, which are quantized by the field. The expected line luminosity from the excitation of these levels by protons which are falling into the polar cap of a neutron star are calculated. They are assumed to attain kinetic energies up to around 200 MeV, the gravitational potential energy at the surface. The cross sections for high energy Coulomb encounters between small pitch angle protons and electrons in a strong field are measured and used to calculate the energy loss rate of the infalling protons. This rate, together with the rate of elastic nuclear proton collisions, is then used to calculate the number of line photons an infalling proton can be expected to produce, directly or indirectly. The results are applied to Hercules X-1. A.R.H.

**N78-31997*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE TRANSFER OF CYCLOTRON LINES THROUGH THE MAGNETOSPHERIC SHELL OF HERCULES X-1** **c93**
Robert P. Weave *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 418-424 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

Cyclotron emission from a strong magnetic field, has been proposed to identify line feature observed in the hard X-ray spectrum of the neutron star Hercules X-1. If this interpretation is indeed correct, and if the model wherein the 1.24 second hard X-ray pulse is due to the occultation of a more isotropic X-ray flux by an opaque magnetospheric shell is accepted then these observations can be used to place strict limits on the total source luminosity of the cyclotron emission. The observational fate of cyclotron line photons that have emerged from the region near the neutron star surface, but have yet to encounter an opaque shell at the magnetosphere is discussed. It is shown that if a narrow line is incident on such a shell, then a residual narrow feature can emerge from the shell. A.R.H.

**N78-31998*#** Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).
**THEORY OF THE ACCRETION COLUMN AND CYCLOTRON RADIATION IN X RAY PULSARS** **c93**
P. Meszaros *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 425-433 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

The energetics of the decelerating matter in the accretion column of X-ray pulsars is considered, in particular the Coulomb process. A two zone model is presented to account for the continuum and cyclotron line emission, incorporating a fan-beam radiation scheme, which appears able to explain the observed properties. Author

**N78-31999*#** Naval Research Lab., Washington, D. C.
**GAMMA RAY SPECTROSCOPY IN ASTROPHYSICS: FUTURE ROLE OF SCINTILLATION DETECTORS** **c35**
J. D. Kurfess *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 438-449 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 14B

The future role of conventional scintillation detector telescopes for line gamma-ray astronomy is discussed. Although the energy resolution of the germanium detectors now being used by several groups is clearly desirable, the larger effective areas and higher efficiencies available with scintillation detectors is advantageous for many observations. This is particularly true for those observations of astrophysical phenomena where significant line broadening is expected. Author

**N78-32000*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**CAPABILITIES OF GERMANIUM DETECTORS** **c35**
J. B. Willett, J. C. Ling, W. A. Mahoney, and A. S. Jacobson *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 450-461 ref (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 14B

The gamma ray detection efficiency and energy resolution of germanium detectors is reviewed. A general sensitivity equation for gamma-ray detectors is presented and calculated sensitvity curves are shown for a large volume balloon-borne spectrometer using germanium detectors. Improvement anticipated from a planned satellite experiment using germanium detectors is discussed. Author

**N78-32001*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**BACKGROUND OF A SHIELDED Ge(Li) SPECTROMETER AT BALLOON ALTITUDES** **c93**
W. A. Mahoney, J. C. Ling, J. B. Willett, and A. S. Jacobson *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 462-472 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

The background data obtained from an actively shielded Ge(Li) spectrometer flown on a balloon were analyzed and a preliminary model was developed to explain background features including the intensity and time profile of line emission. These features can be explained by a combination of secondary radiation originating in the CsI shield and atmospheric secondary radiation leaking thhrough it. Author

**N78-32002*#** California Univ., Berkeley. Lawrence Berkeley Lab.
**RADIATION DAMAGE OF GERMANIUM DETECTORS** **c72**
Richard H. Pehl *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 473-478 refs (For primary document see N78-31971 22-88)

(Contract W-7405-eng-48)
Avail: NTIS HC A25/MF A01 CSCL 20K

Energetic particles can produce interstitial-vacancy pairs in a crystal by knocking the atoms from their normal positions. Detectors are unique among semiconductor devices in depending on very low concentrations of electrically active impurities, and also on efficient transport of holes and electrons over relatively large distances. Because the dense regions of damage produced by energetic particles may result in donors and/or acceptors, and also provide trapping sites for holes and electrons, detectors are very sensitive to radiation damage. In addition to these effects occurring within the detector, radiation may also change the characteristics of the exposed surfaces causing upredictable effects on the detector leakage current. Radiation-induced surface degradation has rarely, if ever, been observed for germanium detectors. The possibility of minimizing hole trapping in charge collection by the use of a high-purity germanium coaxial detector configured with the p (+) contact on the coaxial periphery is discussed. A.R.H.

**N78-32003*#** National Aeronautics and Space Administration, Washington, D. C.
**THE NUCLEAR RADIATION MONITOR FOR THE SPACELAB/SHUTTLE c35**
G. J. Fishman *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 479-483 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 14B

A 5 inch by 5 inch diameter sodium iodide scintillation crystal, viewed by a 5 inch photomultiplier was designed to be mounted near the center of the shuttle payload bay to quantitatively measure the neutron and gamma ray environment during the second Spacelab mission. The expected energy resolution is 8% FWHM at 662 keV. The detector will operate in an energy range from 0.1 to 20 MeV. A charged anticoincidence shield consisting of a 1 cm thick plastic scintillator viewed by three 2 inch photomultiplier tubes, covers the crystal detector which has nearly omnidirectional response. A.R.H.

**N78-32004*#** Columbia Univ., New York. Dept. of Astronomy and Physics.
**GAMMA RAY POLARIMETRY c93**
K. S. Long and R. Novick *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 484-491 refs (For primary document see N78-31971 22-88) (Grant NGR-33-008-102)
(Contrib-156) Avail: NTIS HC A25/MF A01 CSCL 03B

Spectroscopic instruments currently being proposed may possess polarimetric capabilities which sould be nurtured and enhanced to permit characterization of basic emission mechanisms which are impossible using other techniques. Compton scattering and pair production detected the polarization of high energy (E is greater than 50 keV) protons in laboratory experiments. The polarization properties of a detection system consisting of 19 germanium crystals in a closed packed array are examined and the advantages of such a detector over Thompson scattering are discussed. The possiblity of using pair production to detect polarization of high energy gamma rays, and the associated modulation factors are discussed. The central difficulty involved in using pair production polarimeters in astrophysical applications is that the typical opening of the electron or positron direction with respect to the incident photon aircitron is small, of order E/sq mc. Multiple scattering in the material used to convert the photons to an electron positron pair causes deviations in the direction of the electron and positron. A.R.H.

**N78-32005*#** Max-Planck-Institut fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestriche Physik.
**FUTURE DIRECTIONS IN EXPERIMENTAL GAMMA RAY ASTRONOMY c89**
R. C. Haymes *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 492-497 (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03A

Better vehicles and instruments are needed if gamma ray spectroscopy in astrophysics and cosmology is to advance. A gamma ray observatory will (1) permit long-term observations of selected sources to measure their variability and to achieve high sensitivity; (2) measure periods in days or weeks; and (3) assess the entire sky to observe various predicted sources, to measure the energy spectrum, and to map the isotropy of the cosmic ray background over larger collecting areas (of the order of a square meter). Conventional and unconventional instruments must cover the energy range from 0.1 MeV to 20 MeV with improved sensitivity. Angular resolution must be improved one degree or more to study discrete X-ray sources in the galactic center. Actively collimated detectors, improved double Compton instruments, and gamma ray correlators to actively synthesize the absolute energy spectrum of the sky protons are discussed as well as the need for scientific balloons. A.R.H.

**N78-32006*#** Washington Univ., Seattle.
**CROSS SECTIONS RELEVANT TO GAMMA RAY ASTRONOMY c89**
P. Dyer, D. Bodansky, and D. R. Maxson *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 498-501 refs (For primary document see N78-31971 22-88)
(Contract EY-78-C-06-1388; Grant NSF 78-01684)
Avail: NTIS HC A25/MF A01 CSCL 03A

Gamma-ray production cross sections were measured for protons and alpha particles incident on targets consisting of nuclei of high cosmic abundance: C-12, N-14, O-16, Ne-20, Mg-24, Si-28 and Fe-56. Solid or gaseous targets were bombarded by monoenergetic beams of protons and alpha particles, and gamma rays were detected by two Ge(Li) detectors. The proton energy for each target was varied from threshold to about 24 MeV (lab); for alphas the range was from threshold to about 27 MeV. For most transitions, it was possible to measure the total cross section by placing the detectors at 30.5 deg and 109.9 deg where the fourth-order Legendre polynomial is zero. For the case of the 16O (E sub gamma = 6.13 MeV, multipolarity E3) cross sections, yields were measured at four angles. Absolute cross sections were obtained by integrating the beam current and by measuring target thicknesses and detector efficiencies. The Ge(Li) detector resolution was a few keV (although the peak widths were greater, due to Doppler broadening). A.R.H.

**N78-32007*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MEASUREMENTS OF 15.11-MeV GAMMA-RAY FLUX PRODUCED IN THE REACTIONS C-12(P, P')-C-12*(15.11 MeV) AND O-16(P, P' ALPHA)-C-12*(15.11 MeV) c93**
J. R. Lapides, C. J. Crannell, H. Crannell (Catholic Univ. of America), W. F. Hornyak (Maryland Univ., College Park), S. M. Seltzer (National Bureau of Standards), J. I. Trombka (Maryland Univ., College Park), and N. S. Wall *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 502-511 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

The flux of 15.11 MeV gamma rays relative to the flux of 4.44 MeV gamma rays which are emitted from the corresponding states of C-12 are a sensitive measure of the spectrum of exciting particles in solar flares and other cosmic sources. Emission of 15.11 MeV gamma rays may result not only from the direct excitation of C-12 but also from the interaction O-16 (p,p' alpha) C-12* sup 15.11 MeV. Although the cross sections for the direct reaction was studied extensively, the cross section for the spallation interaction with O-16 is not reported in the literature. Preliminary measurements demonstrated the feasibility of measuring the production of 15.11 MeV gamma rays by proton interactions with O-16 using the University of Maryland cyclotron facility. For both carbon and oxygen targets the flux of 15.11 MeV gamma rays is being measured relative to the flux of 4.44 MeV gamma rays. The gamma ray emission from de-excitation of the giant dipole resonances is being measured. A.R.H.

**N78-32008*#** Maryland Univ., College Park.
**GAMMA RAY FACILITIES AT THE UNIVERSITY OF MARYLAND CYCLOTRON c14**
W. F. Hornyak *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 512-514 refs Sponsored in part by NSF (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 14B

A special beam line was set up in a separate shielded experimental room to provide a low background station for

gamma-ray measurements at the University of Maryland cyclotron. The transmitted beam leaving the target is gathered in by a magnetic quadrupole lens located 1.8 m further downstream and focused on a Faraday cup located on the far side of the 2.5 m thick concrete shielding wall of the experimental room. A software computer program permits timing information ot be obtained using the cyclotron beam fine structure as a time reference for the observed gamma-ray events. Measurements indicate a beam fine structure width of less than 1.2 nanoseconds repeated, for example, in the case of 140 MeV alpha particles every 90 nanoseconds. Twelve contignous time channels of adjustable width may be set as desired with reference to the RF signal. This allows the creation of 12 separate 8192 channel analyzers. A.R.H.

**N78-32009*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**THE ISEE-C GAMMA RAY BURST SPECTROMETER c93**

B. J. Teegarden, G. Porreca, D. Stilwell, U. D. Desai, T. L. Cline, and D. Hovestadt *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 516-528 refs (For primary document see N78-31971 22-88)

Avail: NTIS HC A25/MF A01 CSCL 03B

The technical properties, operation, and expected sensitivity are discussed for an experiment intended to search for narrow lines in the spectra of gamma ray bursts during the ISEE-C mission. At the heart of the experiment is a radiatively cooled germanium solid state photon detector. The instrumentation is capable of storing the entire spectrum of all but the largest bursts in the energy range 0.05-6.5 MeV. In addition, it analyzes the signals from two CsI detectors in two other experiments on the spacecraft and records event time histories from these to a few millisecond accuracy. A background mode permits spectral analysis during quiet times and will allow the determination of physically interesting upper limits for narrow lines in the diffuse gamma ray background radiation. A.R.H.

**N78-32010*#** Lockheed Missiles and Space Co., Palo Alto, Calif.

**HIGH RESOLUTION SPECTROSCOPY FROM LOW ALTITUDE SATELLITES c93**

G. H. Nakano and W. L. Imhof *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 529-540 refs Sponsored in part by the Office of Naval Research (For primary document see N78-31971 22-88)

Avail: NTIS HC A25/MF A01 CSCL 03B

The P 78 1 satellite to be placed in a synchronous polar orbit at an altitude of 550-660 km will carry two identical high resolution spectrometers each consisting of a single (approximately 85 cc) intrinsic germanium IGE detector. The payload also includes a pair of phoswitch scintillators, an array of CdTe detectors and several particle detectors, all of which are mounted on the wheel of the satellite. The intrinsic high purity IGE detectors receive cooling from two Stirling cycle refrigerators and facilitate the assembly of large and complex detector arrays planned for the next generation of high sensitivity instruments such as those planned for the gamma ray observatory. The major subsystems of the spectrometer are discussed as well as its capabilities. A.R.H.

**N78-32011*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**HEAO C-1 GAMMA-RAY SPECTROMETER c93**

W. A. Mahoney, J. C. Ling, J. B. Willett, and A. S. Jacobson *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 541-557 refs (For primary document see N78-31971 22-88)

(Contract NAS7-100)

Avail: NTIS HC A25/MF A01 CSCL 03B

The gamma-ray spectroscopy experiment to be launched on the third High Energy Astronomy Observatory (HEAO C) will perform a complete sky search for narrow gamma-ray line emission to the level of about 00001 photons/sq cm -sec for steady point sources. The design of this experiment and its performance based on testing and calibration to date are discussed. Author

**N78-32012*#** New Hampshire Univ., Durham. Dept. of Physics.

**GAMMA RAY SPECTROSCOPY IN ASTROPHYSICS: SOLAR GAMMA RAY ASTRONOMY ON SOLAR MAXIMUM MISSION c93**

D. J. Forrest *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 558-574 refs (For primary document see N78-31971 22-88)

Avail: NTIS HC A25/MF A01 CSCL 03B

The SMM gamma ray experiment and the important scientific capabilities of the instrument are discussed. The flare size detectable as a function of spectrum integration time was studied. A preliminary estimate indicates that a solar gamma ray line at 4.4 MeV one-fifth the intensity of that believed to have been emitted on 4 August 1972 can be detected in approximately 1000 sec with a confidence level of 99%. A.R.H.

**N78-32013*#** National Aeronautics and Space Administration, Washington, D. C.

**THE GAMMA RAY OBSERVATORY c12**

Albert G. Opp *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 575-576 (For primary document see N78-31971 22-88)

Avail: NTIS HC A25/MF A01 CSCL 22A

A large, free-flying space observatory is planned for (1) locating and characterizing gamma ray sources, in particular peculiar objects such as pulsars; (2) studying diffuse gamma ray emission, both from our galaxy and from extragalactic space, (3) investigating other galaxies, especially radio galaxies, Seyfert galaxies and QSOs; and (4) understanding the origin of gamma ray bursts. The spacecraft will weight about 10,000 kg, with about 6,500 kg available for scientific instruments, providing about 400 watts of power to the instruments, and about 12,000 bits per second of telemetry. The spacecraft which will be launched by the space shuttle into a 400 to 500 km circular orbit, inclined at 28.5 deg to the equator, will be three-axis stabilized, with orientation capability of about 20 arc minutes and aspect determination of 2 arc minutes. Absolute timing of 0.1 millisecond will be provided by the spacecraft. The instruments will be co-aligned along one axis of the spacecraft to optimize the spectral coverage of a particular region. A two-year mission is planned with launch in 1984. Possible retrieval by the shuttle at the end of the mission is considered. A.R.H.

**N78-32014*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**SPACECRAFT CHARGING CONTROL BY THERMAL, FIELD EMISSION WITH LANTHANUM-HEXABORIDE EMITTERS**

James F. Morris Aug. 1978 26 p refs

(NASA-TM-78990; E-9773) Avail: NTIS HC A03/MF A01 CSCL 22B

Thermal, field emitters of lanthanum (or perhaps cerium) hexaboride (LaB6) with temperature variability up to about 1500 K are suggested for spacecraft charging control. Such emitters operate at much lower voltages with considerably more control and add plasma-diagnostic versatility. These gains should outweigh the additional complexity of providing heat for the LaB6 thermal, field emitter. L.S.

**N78-32015#** National Aeronautics and Space Administration, Washington, D. C.

**AERONAUTICS AND SPACE REPORT OF THE PRESIDENT: THE 1977 ACTIVITIES**

1978 95 p

Avail: NTIS MF A01; HC SOD

The national programs in aeronautics and space made steady progress in 1977 toward their long-term objectives. In aeronautics the goals were improved performance, energy efficiency, and safety in aircraft. in space the goals were: better remote sensing systems to generate more sophisticated information about the earth's environment; cost effective, versatile space transportation; and understanding the origins and processes of the earth, the solar system, and the Universe. Chapters are devoted to the aeronautic and space activities of six Federal agencies. They are; (1) National Aeronautics and Space Administration; (2) Dept. of Defense; (3) Dept. of Commerce; (4) Dept. of Energy; (5) Dept. of Interior; and (6) Dept. of Transportation. G.Y.

# 89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

**N78-32016*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**X-RAY OBSERVATIONS OF BL Lac OBJECTS**
R. F. Mushotzky, E. A. Boldt, S. A. Holt, S. H. Pravdo, P. J. Serlemitsos, J. H. Swank, and R. H. Rothschild Aug. 1978 13 p refs Submitted for publication
(NASA-TM-79625) Avail: NTIS HC A02/MF A01 CSCL 03A

The BL Lac objects MK501 and MK421 were observed with OSO-8 and HEAO-1 X-ray detectors in the 2-60 keV band. Their spectra are similar with best fitting power laws having energy index -.4 < alpha < 4. A soft X-ray excess is indicated in their spectra. There was no detectable X-ray absorption with implied column densities N sub H < 1.5 x 10 to the 22d power at sq cm. MK421 was a factor 6 weaker in November 1977 than in May 1977. An identification of PKS0548-322 with a new source H0548,-32 is suggested. Author

**N78-32017*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**HIGH ENERGY X-RAY SPECTRA OF CYGNUS XR-1 OBSERVED FROM OSO-8**
J. F. Dolan, C. J. Crannell, B. R. Dennis, K. J. Frost, and L. E. Orwig Aug. 1978 26 p refs Submitted for publication
(NASA-TM-79626) Avail: NTIS HC A03/MF A01 CSCL 03A

X-ray spectra of Cygnus XR-1 were measured with the scintillation spectrometer on board the OSO-8 satellite during a period of one and one-half to three weeks in each of the years from 1975 to 1977. Observations were made when the source was both in a high state and in a low state. Typical spectra of the source between 15 and 250 keV are presented. The observed pivoting effect is consistent with two temperature accretion disk models of the X-ray emitting region. No significant break in the spectrum occurred at energies up to 150 keV. The high state as defined in the 3 to 6 keV bandwidth was found to be the higher luminosity state of the X-ray source. One transition from a low to a high state occurred during observations. The time of occurrence of this and other transitions is consistent with the hypothesis that all intensity transitions occur near periastron of the binary system, and that such transitions are caused by changes in the mass transfer rate between the primary and the accretion disk around the secondary. L.S.

**N78-32018*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**COMET TEMPEL 2: ORBIT, EPHEMERIDES AND ERROR ANALYSIS**
D. K. Yeomans 15 Sep. 1978 35 p
(Contract NAS7-100)
(NASA-CR-157598; JPL-Pub-78-85) Avail: NTIS HC A03/MF A01 CSCL 03A

The dynamical behavior of comet Tempel 2 is investigated and the comet is found to be very well behaved and easily predictable. The nongravitational forces affecting the motion of this comet are the smallest of any comet that is affected by nongravitational forces. The sign and time history of these nongravitational forces imply (1) a direct rotation of the comet's nucleus and (2) the comet's ability to outgas has not changed substantially over its entire observational history. The well behaved dynamical motion of the comet, the well observed past apparitions, the small nongravitational forces and the excellent 1988 ground based observing conditions all contribute to relatively small position and velocity errors in 1988 -- the year of a proposed rendezvous space mission to this comet. To assist in planned ground based and earth orbital observations of this comet, ephemerides are given for the 1978-79, 1983-84 and 1988 apparitions. Author

**N78-32019#** Leicester Univ. (England). Dept. of Astronomy.
**SATELLITE OPTICAL TRACKING: SPIN DECAY AND FLASH OBSERVATIONS**
V. Williams and A. J. Meadows Sep. 1977 71 p refs
Avail: NTIS HC A04/MF A01

The periodic changes of brightness of many of the artificial earth satellites which can be seen with the naked eye or with the aid of binoculars are generally due to tumbling or spinning of the satellites which changes the aspect of reflecting surfaces on the satellites to the sun and the observer. The variations are most easily noticed when the rotation period is of the order of a few seconds, and can take on a smoothly-changing nature, a flashing appearance, or some combination of the two. Among the factors causing changes in satellite rotation are air drag and eddy current torques. The dynamics of discarded rocket bodies are deduced from observations of the flash period and used to estimate the torques acting on them. From the estimated torques, statements are made about the air density and magnetic field near orbit. A.R.H.

**N78-32020#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**CALIBRATION AND POSITIONAL DETERMINATION OF BOLLER AND CHIVENS 31-INCH TELESCOPE B**
Lawrie E. Eaton and Robert L. Irelan Apr. 1978 21 p ref
(Contract F19628-78-C-0002; AF Proj. 2128)
(AD-A055266; ETS-29; ESD-TR-78066) Avail: NTIS HC A02/MF A01 CSCL 17/8

This report describes the methods presently used to determine the position of the second Boller and Chivens telescope (telescope B) at the GEODSS ETS. Also discussed is a system devised for auto-calibration of the telescope position. Author (GRA)

**N78-32021#** Basel Univ. (Switzerland). Astronomical Inst.
**PHOTOMETRIC CATALOGUE FOR STARS IN SELECTED AREAS AND OTHER FIELDS IN THE RGU-SYSTEM. VOLUME 1: SELECTED AREAS 51, 54, 57, 82, 107**
W. Becker and R. Fenkart 1976 110 p 3 Vol.
Avail: NTIS HC A06/MF A01

Each star measured on 48 in. Palomar-Schmidt plates in the different fields of the AIBU halo-program is represented by its numbers, its G-magnitude, its long-and short-wave color indices, G-R and U-G respectively, and a letter corresponding to the type of star. ESA

**N78-32022#** Basel Univ. (Switzerland). Astronomical Inst.
**PHOTOMETRIC CATALOGUE FOR STARS IN SELECTED AREAS AND OTHER FIELDS IN THE RGU-SYSTEM. VOLUME 2: SELECTED AREAS 71, 94, 141; M3, M13, NGC4147**
W. Becker, R. Fenkart, R. Schaltenbrand, R. Wagner, and F. Yilmaz 1976 97 p refs 3 Vol.
Avail: NTIS HC A05/MF A01
For abstract, see N78-32021.

**N78-32023#** Basel Univ. (Switzerland). Astronomical Inst.
**PHOTOMETRIC CATALOGUE FOR STARS IN SELECTED AREAS AND OTHER FIELDS IN THE RGU-SYSTEM. VOLUME 3: MILKY WAY FIELDS PERSEUS 1, NGC 1664, M 37 1, M 37 2, NGC 6067, SAGITTARIUS 1**
W. Becker, R. Fenkart, C. Fang, H. Fuenfschilling, N. Svolopoulos, L. Topaktas, W. Wooden, and F. Yilmaz 1977 125 p refs 3 Vol.
Avail: NTIS HC A06/MF A01
For abstract, see N78-32021.

**N78-32024#** Applications Mathematiques et Logiciel (AML) SARL, Neuilly-sur-Seine (France).
**ASTROMETRY SATELLITE. THEORETICAL STUDY OF THE ACCURACY. VOLUME 1: MODELS AND ALGORITHMS**
Simon J. Larcher Paris ESA Apr. 1978 275 p refs Prepared jointly with Anal. and Computational Math. (ACM), Zurich 2 Vol.
(Contract ESA-3175/77-F-HGE(SC))
(ESA-CR(P)-1068-Vol-1) Avail: NTIS HC A12/MF A01

A theoretical study of the accuracy of an astrometric satellite was made. Mathematical models and computer programming techniques were used to select an optimum mission configuration. The accuracy to be gained on astrometric parameters was evaluated at each stage of the processing. A flexible model of the satellite payload was prepared, which achieves a rigorous modeling of every system in a logical breakdown. Details both of the complete model, which is well suited for sensitivity studies, and of simplified models, sufficient for data processing under

normal conditions, are given. A decomposed scheme for the processing of the measured data is given. The first step can be advantageously performed in near real time by means of a filtering algorithm of a non-classical type, and the other two steps can be performed by batch fitting. ESA

**N78-32025#** Applications Mathematiques et Logiciel (AML) SARL, Neuilly-sur-Seine (France).
**ASTROMETRY SATELLITE. THEORETICAL STUDY OF THE ACCURACY. VOLUME 2: NUMERICAL EXPERIMENTS**
Jacques R. Boissieres and Simon J. Larcher Paris ESA Apr. 1978 94 p 2 Vol.
(Contract ESA-3175/77-F-HGE(SC))
(ESA-CR(P)-1068-Vol-2) Avail: NTIS HC A05/MF A01

As part of a theoretical study on the accuracy of an astronomy satellite, the first numerical results obtained with the software developed are presented. Topics include evaluation of the modulation transfer functions, grid optimization, filtering algorithms and coefficients of improvements. ESA

**N78-31982*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**RICE UNIVERSITY OBSERVATIONS OF THE GALACTIC CENTER**
Charles A. Meegan *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 223-227 refs (For primary document see N78-31971 22-90)
Avail: NTIS HC A25/MF A01 CSCL 03A

**N78-31986*#** Commissariat a l'Energie Atomique, Saclay (France).
**GAMMA RAY ASTRONOMY AND THE ORIGIN OF THE LIGHT NUCLEI**
Hubert Reeves *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 283-301 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03A

**N78-32005*#** Max-Planck-Institut fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestriche Physik.
**FUTURE DIRECTIONS IN EXPERIMENTAL GAMMA RAY ASTRONOMY**
R. C. Haymes *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 492-497 (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03A

**N78-32006*#** Washington Univ., Seattle.
**CROSS SECTIONS RELEVANT TO GAMMA RAY ASTRONOMY**
P. Dyer, D. Bodansky, and D. R. Maxson *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 498-501 refs (For primary document see N78-31971 22-88)
(Contract EY-78-C-06-1388; Grant NSF 78-01684)
Avail: NTIS HC A25/MF A01 CSCL 03A

# 90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

**N78-32026** Virginia Univ., Charlottesville.
**GAS RESPONSE TO PERTURBATIONS IN DISK GALAXIES Ph.D. Thesis**
James Michael Huntley 1977 136 p
Avail: Univ. Microfilms Order No. 78-12115

Two-dimensional, numerical hydrodynamics were used to investigate the response of gaseous components to rotating perturbations in the axisymmetric gravitational fields of the disks. The purpose of these calculations was to determine the form of the steady-state gas density and flow distributions which develop in response to various bar-like perturbations. The gas response to spiral perturbations was also calculated for the purpose of comparison with the results of the bar-like cases. The calculations reveal that gas responds to the presence of bar-like perturbations by forming an elliptical bar in the central regions of the disk and by forming open, two-armed, trailing spiral waves in the outer regions. Gas responds to a tightly-wound spiral perturbation by forming two-armed, trailing spiral waves which are in phase with the applied perturbation. Dissert. Abstr.

**N78-32027*#** Ohio State Univ., Columbus. Dept. of Geodetic Science.
**EARTH ORIENTATION FROM LUNAR LASER RANGE-DIFFERENCING Ph.D. Thesis**
Alfred Leick Jun. 1978 121 p refs
(Grant NsG-5265; OSURF Proj. 711055)
(NASA-CR-157592; OSU-263) Avail: NTIS HC A06/MF A01 CSCL 03B

For the optimal use of high precision lunar laser ranging (LLR), an investigation regarding a clear definition of the underlying coordinate systems, identification of estimable quantities, favorable station geometry and optimal observation schedule is given.G.G.

**N78-32028*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**M2 OCEAN TIDE PARAMETERS AND THE DECELERATION OF THE MOON'S MEAN LONGITUDE FROM SATELLITE ORBIT DATA**
T. L. Felsentreger, J. G. Marsh, and R. G. Williamson (Wolf Research and Development Corp., Riverdale, Md.) Jun. 1978 24 p refs Presented at Ann. Spring Meeting of Am. Geophysical Union, Miami Beach, Fla., 17-21 Apr. 1978 Submitted for publication
(NASA-TM-79571) Avail: NTIS HC A02/MF A01 CSCL 03B

An estimation was made of the principal long period spherical harmonic parameters in the representation for the M sub 2 ocean tide from the orbital histories of three satellites - 1967-92A (TRANSIT), Starlette, and GEOS-3. The data used were primarily the evolution of the orbital inclinations of the satellites, with the addition of the longitude of the ascending node from GEOS-3. The results are: (1) C sub 22 superscript + = 3.42 plus or minus 0.24 cm; (2) sub 42 superscript + = 0.97 plus or minus 0.12 cm; (3) epsilon subscript 22 superscript + = 325 D.5 plus or minus 3.D9; (4) epsilon subscript 42 superscript + = 42 = 124D.0 plus or minus 6 D.9. These values agree quite well with recent numerical models and another recent determination from satellite data. The M sub 2 parameters obtained here infer an N of -25 plus or minus 3 arc seconds/century squared, in good agreement with other investigators. The range of current determinations of N is from -24.6 to 27.2 arc second/century squared. L.S.

**N78-31973*#** New Hampshire Univ., Durham. Dept. of Physics.
**GAMMA RAY SPECTROSCOPY IN ASTROPHYSICS: AN OBSERVATIONAL OVERVIEW (50 keV-20 MeV)**
E. L. Chupp *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 42-68 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

# 91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

**N78-32029*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**CRUSTAL EVOLUTION INFERRED FROM APOLLO MAGNETIC MEASUREMENTS**
Palmer Dyal, William D. Daily (Eyring Res. Inst.), and Leonid L. Vanyan (Acad. of Sci., Moscow) Sep. 1978 31 p refs
(Grant NsG-2082)
(NASA-TM-78524; A-7608) Avail: NTIS HC A03/MF A01 CSCL 03B

Magnetic field and solar wind plasma density measurements were analyzed to determine the scale size characteristics of remanent fields at the Apollo 12, 15, and 16 landing sites. Theoretical model calculations of the field-plasma interaction, involving diffusion of the remanent field into the solar plasma, were compared to the data. The information provided by all these experiments shows that remanent fields over most of the lunar surface are characterized by spatial variations as small as a few kilometers. Large regions (50 to 100 km) of the lunar crust were probably uniformly magnetized during early crustal evolution. Bombardment and subsequent gardening of the upper layers of these magnetized regions left randomly oriented, smaller scale (5 to 10 km) magnetic sources close to the surface. The larger scale size fields of magnitude approximately 0.1 gammas are measured by the orbiting subsatellite experiments and the small scale sized remanent fields of magnitude approximately 100 gammas are measured by the surface experiments. Author

# 92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

**N78-32030** Maryland Univ., College Park.
**RESONANT ABSORPTION OF ALFVENIC SURFACE WAVES AND THE HEATING OF SOLAR CORONAL LOOPS Ph.D. Thesis**
James Albert Ionson 1977 143 p
Avail: Univ. Microfilms Order No. 78-11954

The macroscopic response of a magnetoplasma subject to the effect of externally driven Alfvenic surface waves is analysed to determine the manner in which loops in coronal active regions are heated, Considered are the physics involved in thermalization of the surface wave's energy heating by Alfvenic surface waves on the background and the effects of plasma. The surface wave experiences a resonance within the coronal loop where the phase velocity of the surface wave matches that of a local shear body wave. A kinetic description reveals the fact that propagation of shear waves (kinetic Alfven waves) takes place across field lines. Furthermore, a kinetic description of shear waves reveals efficient thermalization of a kinetic Alfven wave and thus of the original surface wave. Because the heating is localized in a relatively thin shell, the surrounding plasma responds by evolving into a connective flow field. Dissert. Abstr.

**N78-32031*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SOLAR GAMMA RAYS ABOVE 8 MeV**
Carol Jo. Crannell, Hall Crannell (Catholic Univ. of America), and Reuven Ramaty Aug. 1978 41 p refs Submitted for publication
(NASA-TM-79623) Avail: NTIS HC A03/MF A01 CSCL 03B

Processes which lead to the production of gamma rays with energy greater than 8 MeV in solar flares are reviewed and evaluated. Excited states produced by inelastic scattering, charge exchange, and spallation reactions in the abundant nuclear species are considered in order to identify nuclear lines which may contribute to the Gamma ray spectrum of solar flares. The flux of 15.11 MeV Gamma rays relative to the flux of 4.44 MeV Gamma rays from the de-excitation of the corresponding states in C12 is calculated for a number of assumed distributions of exciting particles. This flux ratio is a sensitive diagnostic of accererated particle spectra. Other high energy nuclear levels are not so isolated as the 15.11 MeV state and are not expected to be so strong. The spectrum of Gamma rays from the decay of Pi dey is sensitive to the energy distribution of particles accelerated to energies greater than 100 MeV. Author

**N78-32032*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**THE ENERGETIC PARTICLE ENVIRONMENT OF THE SOLAR PROBE MISSION: AS ESTIMATED BY THE PARTICIPANTS OF THE SOLAR PROBE ENVIRONMENT WORKSHOP**
M. Neugebauer, L. A. Fisk (New Hampshire Univ.), R. E. Gold (Johns Hopkins Univ.), R. P. Lin (California Univ., Berkeley), G. Newkirk (National Center for Atmospheric Research, Boulder, Colo.), J. A. Simpson (Chicago Univ.), and M. A. I. VanHollebeke 1 Sep. 1978 53 p Workshop held at Pasadena, Calif., 19-20 Jan. 1978
(Contract NAS7-100)
(NASA-CR-157595; JPL-Pub-78-64) Avail: NTIS HC A04/MF A01 CSCL 03B

NASA's long-range plan for the study of solar-terrestrial relations includes a Solar Probe Mission in which a spacecraft is placed in an eccentric orbit with perihelion at four solar radii. Possible radiation damage to the spacecraft and mission from energetic particles was discussed at a Solar Probe Environment Workshop which concluded that it would be unlikely for such a spacecraft to suffer fatal radiation damage, although a severe problem exists in limiting the neutron flux from a radioactive power supply enough to allow solar neutrons to be detected. A.R.H.

**N78-32033#** Parametrics, Inc., Waltham, Mass.
**MEASUREMENT OF 200-400 nM SOLAR UV FLUXES AT ALTITUDES UP TO 39 km ON THE STRATCOM 7-A BALLOON FLIGHT Final Report, Aug. 1976 - Sep. 1977**
Frederick A. Hanser, Bach Sellers, and Jean L. Hunerwadel Sep. 1977 32 p refs
(Contract DAAD07-75-C-0124)
(AD-A055774; PANA-AIR-3) Avail: NTIS HC A03/MF A01 CSCL 04/1

Solar UV fluxes in the 200-400 nm range have been measured at up to 39 km altitude on the Stratcom VII-A balloon flight. A filter-wheel UV Spectrophotometer was used to make measurements at ten wavelengths over this range. Flux vs solar zenith angle data were obtained for ascent, descent/sunset, sunrise and cut-down. Ascent, descent/sunset, and load cut-down gave vertical profiles of solar UV flux to below 10 km. The total ozone values derived from the UVS measured fluxes allow ozone densities to be calculated for ascent and descent which are in good agreement with the measured local ozone densities. A good measurement of the 220 nm solar flux in the ozone-oxygen atmospheric window was made. The result is .00000327 W/sq cm-nm), and together with other measurements indicates some dependence of the 220 nm solar flux on sunspot number and 2800 MHz solar flux. GRA

**N78-31974*#** Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
**A HARD X-RAY AND GAMMA RAY OBSERVATION OF THE 22 NOVEMBER 1977 SOLAR FLARE**
G. Chambon, K. Hurley, M. Niel, R. Talon, G. Vedrenne, O. B. Likine (IKI, Moscow), A. V. Kouznetsov (IKI, Moscow), and I. V. Estouline (IKI, Moscow) *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 70-75 refs
(For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31975*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GAMMA RAY EMISSION AND SOLAR FLARES**
R. P. Lin (California Univ., Berkeley) and R. Ramaty *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 76-96 refs
(For primary document see N78-31971 22-92)
(Grant NGL-05-003-017)
Avail: NTIS HC A25/MF A01 CSCL 03B

# 93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

**N78-32034*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GAMMA-RAY EVIDENCE FOR A GALACTIC HALO**
F. W. Stecker Jun. 1978 9 p refs Presented at IAU Symp. no. 84 on the Large Scale Characteristics of the Galaxy, 12-17 Jun. 1978, College Park, Md.
(NASA-TM-79570) Avail: NTIS HC A02/MF A01 CSCL 03B

Gamma ray data favor a cosmic ray propagation halo comparable with the thickness of the primary radio emission disk of our Galaxy and the halo seen around NGC891. L.S.

**N78-31972*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MECHANISMS AND SITES FOR ASTROPHYSICAL GAMMA RAY LINE PRODUCTION**
R. Ramaty *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 7-41 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31976*#** Los Alamos Scientific Lab., N. Mex.
**PLANETARY GAMMA-RAY SPECTROSCOPY**
Robert C. Reedy *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 98-148 refs Sponsored in part by NASA and DOE (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31977*#** Los Alamos Scientific Lab., N. Mex.
**NUCLEAR GAMMA RAYS FROM STELLAR FLARES**
Stirling A. Colgate *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 149-167 refs Sponsored in part by NASA, DOE, and the Aspen Inst. of Physics (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31978*#** Bell Telephone Labs., Inc., Murray Hill, N. J.
**DETECTION OF 511 keV POSITRON ANNIHILATION RADIATION FROM THE GALACTIC CENTER DIRECTION**
M. Leventhal, C. J. MacCallum, and P. D. Stang *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 169-189 refs Sponsored by ERDA. Prepared in cooperation with Sandia Labs., Albuquerque, N. Mex. (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31979*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE GALACTIC GAMMA-RAY FLUX IN THE 0.06 TO 5 MeV RANGE**
D. Gilman (JPL), A. E. Metzger (JPL), R. H. Parker (JPL), and J. I. Trombka *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 190-206 refs (For primary document see N78-31971 22-88)
(Contract NAS7-100)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31980*#** Max-Planck-Institut fuer Physik und Astrophysik, Garching (West Germany).
**LOW ENERGY GAMMA RAY OBSERVATIONS WITH THE MPI-COMPTON TELESCOPE**
F. Graml, F.-P. Penningsfeld, and V. Schoenfelder *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 207-216 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31981*#** California Univ., Riverside. Dept. of Physics.
**SEARCH FOR BROAD GAMMA RAY LINES WITH THE UCR DOUBLE COMPTON SCATTER TELESCOPE**
R. Stephen White, James M. Ryan, Robert B. Wilson, Allen D. Zych, and Bruce Dayton (California State Univ., Los Angeles) *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 217-222 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31983*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**OBSERVATIONAL EVIDENCE FOR EXTRATERRESTRIAL GAMMA-RAY LINE SOURCES**
A. S. Jacobson, J. C. Ling, W. A. Mahoney, and J. B. Willett *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 228-251 refs (For primary document see N78-31971 22-88)
(Contract NAS7-100)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31984*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**NUCLEAR GAMMA RAYS FROM COMPACT OBJECTS**
R. E. Lingenfelter (California Univ., Los Angeles), J. C. Higdon (Arizona Univ., Tucson), and R. Ramaty *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 252-274 refs (For primary document see N78-31971 22-88)
(Grants NsG-7101; NSF AST-76-08178)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31985*#** Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
**GAMMA-RAY LINES FROM NEUTRON STARS AS PROBES OF FUNDAMENTAL PHYSICS**
Kenneth Brecher *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 275-282 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31987*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GALACTIC CENTER IRON LINE EMISSION**
D. M. Worrall, E. A. Boldt, S. S. Holt, S. H. Pravdo, and P. J. Serlemitsos *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 302-309 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31988*#** Chicago Univ., Ill.
**GAMMA LINE RADIATION FROM SUPERNOVAE**
W. D. Arnett *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 310-314 refs (For primary document see N78-31971 22-88)
(Grant NSF 76-20253)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31989*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GAMMA RAY LINES FROM NOVAE**
James W. Truran (Illinois Univ.), Sumner G. Starrfield (Arizona State Univ.), and Warren M. Sparks *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 315-322 refs (For primary document see N78-31971 22-88)
(Grants NSF AST-76-22673; NSF AST-77-23190)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31990*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GAMMA-RAY LINE EMISSION ABOVE 8 MeV**
C. J. Crannell and H. Crannell (Catholic Univ. of Am.) *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 323-329 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31991*#** Max-Planck-Institut fuer Physik und Astrophysik, Garching (West Germany).
**CYCLOTRON LINES FROM Her X-1**
J. Truemper *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 331-345 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31992*#** Commissariat a l'Energie Atomique, Saclay (France).
**CONFIDENCE ABOUT LINE FEATURES IN Her X-1 SPECTRUM**
Ph. Durouchoux, D. Boclet, and R. Rocchia *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 346-370 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31993*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**UPPER LIMITS ON THE CYCLOTRON LINES FROM Her X-1 AS OBSERVED WITH OSO-8**
B. R. Dennis, G. S. Maurer (Catholic Univ. of Am., Washington, D. C.), E. P. Cutler (Comtech, Lanham, Md.), C. J. Crannell, J.

F. Dolan, K. J. Frost, and L. E. Orwig *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 371-385 refs (For primary document see N78-31971 22-88)
(Contract NAS5-24451; Grant NsG-5066)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31994*#** California Univ., San Diego. Dept. of Physics.
**HEAO-1 OBSERVATIONS OF Her X-1 AT ENERGIES ABOVE 13 keV**
J. L. Matteson, D. E. Gruber, and J. A. Hoffman *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 386-393 Prepared in cooperation with Massachusetts Inst. of Technology (For primary document see N78-31971 22-88)
(Contract NAS8-27974)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31995*#** Daugherty (J. K.), Durham, N. C.
**CYCLOTRON EMISSION IN NEUTRON STAR MAGNETOSPHERES**
J. K. Daugherty *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 394-403 (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31996*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE EXCITATION OF ELECTRONIC TRANSVERSE ENERGY LEVELS IN AN INTENSE MAGNETIC FIELD**
Roger W. Bussard *In its* Gamma Ray Spectry. In Astrophys. Aug. 1978 p 404-417 (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31997*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE TRANSFER OF CYCLOTRON LINES THROUGH THE MAGNETOSPHERIC SHELL OF HERCULES X-1**
Robert P. Weave *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 418-424 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-31998*#** Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).
**THEORY OF THE ACCRETION COLUMN AND CYCLOTRON RADIATION IN X RAY PULSARS**
P. Meszaros *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 425-433 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-32001*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**BACKGROUND OF A SHIELDED Ge(Li) SPECTROMETER AT BALLOON ALTITUDES**
W. A. Mahoney, J. C. Ling, J. B. Willett, and A. S. Jacobson *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 462-472 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-32004*#** Columbia Univ., New York. Dept. of Astronomy and Physics.
**GAMMA RAY POLARIMETRY**
K. S. Long and R. Novick *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 484-491 refs (For primary document see N78-31971 22-88)
(Grant NGR-33-008-102)
(Contrib-156) Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-32007*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MEASUREMENTS OF 15.11-MeV GAMMA-RAY FLUX PRODUCED IN THE REACTIONS C-12(P, P')C-12*(15.11 MeV) AND O-16(P, P' ALPHA)C-12*(15.11 MeV)**
J. R. Lapides, C. J. Crannell, H. Crannell (Catholic Univ. of America), W. F. Hornyak (Maryland Univ., College Park), S. M. Seltzer (National Bureau of Standards), J. I. Trombka (Maryland Univ., College Park), and N. S. Wall *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 502-511 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-32009*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE ISEE-C GAMMA RAY BURST SPECTROMETER**
B. J. Teegarden, G. Porreca, D. Stilwell, U. D. Desai, T. L. Cline, and D. Hovestadt *In its* Gamma Ray Spectry. in Astrophys. Aug. 1978 p 516-528 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-32010*#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**HIGH RESOLUTION SPECTROSCOPY FROM LOW ALTITUDE SATELLITES**
G. H. Nakano and W. L. Imhof *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 529-540 refs Sponsored in part by the Office of Naval Research (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-32011*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**HEAO C-1 GAMMA-RAY SPECTROMETER**
W. A. Mahoney, J. C. Ling, J. B. Willett, and A. S. Jacobson *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 541-557 refs (For primary document see N78-31971 22-88)
(Contract NAS7-100)
Avail: NTIS HC A25/MF A01 CSCL 03B

**N78-32012*#** New Hampshire Univ., Durham. Dept. of Physics.
**GAMMA RAY SPECTROSCOPY IN ASTROPHYSICS: SOLAR GAMMA RAY ASTRONOMY ON SOLAR MAXIMUM MISSION**
D. J. Forrest *In* NASA. Goddard Space Flight Center Gamma Ray Spectry. in Astrophys. Aug. 1978 p 558-574 refs (For primary document see N78-31971 22-88)
Avail: NTIS HC A25/MF A01 CSCL 03B

# 99 GENERAL

**N78-32035#** Committee on Science and Technology (U. S. House).
**ASTRONAUTS AND COSMONAUTS BIOGRAPHICAL AND STATISTICAL DATA, REVISED 31 MAY 1978**
Washington GPO 1978 260 p refs Rept. for Comm. on Sci. and Technol., 95th Congr., 2d Sess., Jul. 1978 Prepared by the Library of Congr., Congressional Res. Service
(GPO-30-531) Avail: SOD HC

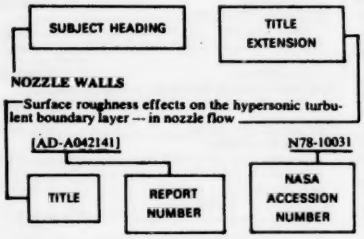
The original educational, experimental, medical and psychological criteria for the selection of NASA astronauts are reviewed and changes for current astronaut candidates are examined. Photographs and biographical sketches are included for all NASA astronaut candidates, crews of the X-15, X-20, and Manned Orbiting Laboratory, and for the Soviet-Bloc cosmonauts. The service affiliation of astronauts and astronaut candidates and their educational status at the time of selection listed in tables as well as data on American and Soviet manned spaceflights including mission profiles, time lines, crew members by program, time spent on space missions, time spent on extravehicular activity, and manned space flights by program. A list of deceased astronauts and cosmonauts is included. A.R.H.

# SUBJECT INDEX





## Typical Subject Index Listing

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## A

**ABSORPTION SPECTROSCOPY**
Determination of low-level mercury by cold vapor generation and atomic absorption spectroscopy
[ARH-LD-160] N78-31203
**ABSORPTIVITY**
Design of a flow facility for quantitative spectroscopic studies of high temperature species --- infrared absorption coefficients of boron compounds in the vapor phase
[AD-A054842] N78-31187
**ABSTRACTS**
Telecommunication: Economic studies. A bibliography with abstracts
[NTIS/PS-78/0581/5] N78-31352
Nondestructive ultrasonic testing and inspection, volume 2. Citations from the Engineering Index data base
[NTIS/PS-78/0567/4] N78-31450
Nondestructive ultrasonic testing and inspection, volume 3. Citations from the Engineering Index data base
[NTIS/PS-78/0568/2] N78-31451
Decision making in management. A bibliography with abstracts
[NTIS/PS-78/0605/2] N78-31947
Copyrights. A bibliography with abstracts
[NTIS/PS-78/0529/4] N78-31959
**ACCELERATED LIFE TESTS**
Evaluation program for secondary spacecraft cells
[NASA-CR-156812] N78-31540
**ACCELERATION (PHYSICS)**
Influence of acceleration on surface acoustic wave oscillators
N78-31286
**ACCELEROMETERS**
Statistical review of counting accelerometer data for Navy and Marine fleet aircraft from 1 Jan. 1962 to 31 Dec. 1977
[AD-A055672] N78-31098
Measurements of atmospheric density at Kwajalein Atoll, 18 May 1977
[AD-A054784] N78-31640
**ACCEPTABILITY**
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 1
[NASA-CR-150791] N78-31159
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 1, section 2
[NASA-CR-150792] N78-31160
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 2
[NASA-CR-150793] N78-31161
**ACCURACY**
Theoretical and experimental investigation of computation errors in two different strapdown inertial navigation [IN]-systems
[FOA-C-20217-E4] N78-31080
Software tool [S] for evaluating the effects of finite wordlength
[AD-A055777] N78-31806
Astrometry satellite. Theoretical study of the accuracy. Volume 1: Models and algorithms
[ESA-CR[P]-1068-VOL-1] N78-32024
Astrometry satellite. Theoretical study of the accuracy. Volume 2: Numerical experiments
[ESA-CR[P]-1068-VOL-2] N78-32025
**ACETYLENE**
Infrared studies of the solid state polymerization of diacetylene monomers
[AD-A055988] N78-31244
**ACIDS**
Cleaning coal with coal: Coal humic acids for removal of acids, alkali, salinity, and heavy metal pollutants associated with the use of coal as a fuel
[PB-280580/2] N78-31608
**ACOUSTIC DELAY LINES**
Microwave surface-acoustic-wave components
N78-31283
Influence of acceleration on surface acoustic wave oscillators
N78-31286
Systems applications of SAW filters and delay lines
N78-31294
**ACOUSTIC MEASUREMENTS**
Correlation of combustor acoustic power levels inferred from internal fluctuating pressure measurements
[NASA-TM-78986] N78-31871
**ACOUSTIC PROPERTIES**
A comparison between derived internal dielectric properties and radio-echo sounding records of the ice sheet at Cape Folger, Antarctica
[AD-A055245] N78-31638
**ACOUSTICAL HOLOGRAPHY**
Development and evaluation of an ultrasonic imaging system
[PB-279834/6] N78-31729
**ACOUSTICS**
Diagnostic improvements in medical ultrasonic imaging systems
N78-31710
**ACTINIDE SERIES COMPOUNDS**
Magnetic susceptibility of AnRe2 compounds
[CONF-771127-15] N78-31195
**ACTIVATED SLUDGE**
Effects of water-treatment-plant wastes on domestic wastewater treatment processes --- alum sludge disposal
[PB-280970/5] N78-31968
**ACTUATORS**
A pressure limiting propellant actuating system
[NASA-CASE-MSC-18179-1] N78-31162
Actuator mechanism
[NASA-CASE-GSC-11883-2] N78-31426
**ADAPTIVE CONTROL**
UHF adaptive array development program
[AD-A055942] N78-31339
Computation expressions and their applications in an adaptive computer system
N78-31814
Multidomain algorithm evaluation, volume 1
[AD-A054357] N78-31826
Multidomain algorithm evaluation, volume 2
[AD-A054358] N78-31827
Adaptive compensation techniques
[AD-A055177] N78-31828
On the dual-adaptive control and its practical applications
[CEPHAG-52/77] N78-31832
**ADAPTIVE FILTERS**
Walsh adaptive filter
[AD-A055170] N78-31328
Adaptive Kalman type estimation applied to image processing
[AD-A055827] N78-31365
**ADDITIVES**
Inhibition of hot salt corrosion by metallic additives
[NASA-TM-78966] N78-31208
**ADENOSINES**
The effect of high altitude on pyridine nucleotides and adenosine phosphates in the liver of the rat
N78-31689
**ADHESION**
Reproducible adhesion test for soldered thick-film conductors
[AD-A054971] N78-31361
**ADHESIVE BONDING**
Feasibility of using fluorescent materials in product assurance applications and for locating adhesive bond fractures
[AD-A055979] N78-31245
**ADJUSTING**
Optical measurement of the radio interferometer of the DFVLR
[DLR-IB-551-77/13] N78-31901
**AERIAL EXPLOSIONS**
Hazard assessment of aircraft gun compartments
[AD-A055026] N78-31064
**AERIAL PHOTOGRAPHY**
High altitude perspective --- cost-reimbursable services using NASA U-2 aircraft
[NASA-SP-427] N78-31508
**AERODYNAMIC CHARACTERISTICS**
Analysis of stability contributions of high dihedral 'tails
[NASA-TM-78729] N78-31044
Aerodynamic characteristics of a hypersonic research airplane concept having a 70 deg swept double-delta wing at Mach number 0.2
[NASA-TP-1252] N78-31045
Aeroballistics of corkscrew projectiles
[AD-A054735] N78-31049
Development of a computer program to calculate aerodynamic characteristics of bodies and wing-body combinations --- surface pressure distribution in supersonic flow
[AD-A055846] N78-31053
Hybrid trajectory simulation of a parachute system --- low impact velocity two parachute system aerodynamics
[SAND-78-8668] N78-31054
The design and aerodynamic characteristics of the RAE 5215 aerofoil
[ARC-CP-1386] N78-31055
**AERODYNAMIC COEFFICIENTS**
Maximum likelihood identification of the longitudinal aerodynamic coefficients of the EA-6B airplane in the catapult launch configuration
[AD-A054243] N78-31046
**AERODYNAMIC DRAG**
Aeroballistics of corkscrew projectiles
[AD-A054735] N78-31049
Measurements of atmospheric density at Kwajalein Atoll, 18 May 1977
[AD-A054784] N78-31640
**AERODYNAMIC FORCES**
An automated procedure for computing the three-dimensional transonic flow over wing-body combinations, including viscous effects. Volume 1: Description of analysis methods and applications
[AD-A055899] N78-31052
**AERODYNAMIC HEAT TRANSFER**
Investigation on the influence of a hydrodynamic precursor stage on the heat transfer at a flat channel wall
[ILR-22] N78-31397
**AERODYNAMICS**
Aeronautical engineering: A continuing bibliography with indexes, supplement 98
[NASA-SP-7037(98)] N78-31041
**AERONAUTICAL ENGINEERING**
Aeronautical engineering: A continuing bibliography with indexes, supplement 98
[NASA-SP-7037(98)] N78-31041
**AEROSOLS**
Development of a portable device to collect sulfuric acid aerosol
[PB-280048/0] N78-31603
Organic characterization of aerosols and vapor phase compounds in urban atmospheres
[PB-280050/6] N78-31611
Development and fabrication of a prototype Fibrous Aerosol Monitor [FAM]
[PB-280126/4] N78-31613

Toxicological evaluation of Pyrethrins Fogging Concentrate [trade name] study No. 51-1309-78
[AD-A055088] N78-31715

**AEROSPACE MEDICINE**

Translations on USSR science and technology: Biomedical and behavioral sciences, no. 35
[JPRS-71467] N78-31694

Aerospace medicine and biology: A continuing bibliography with indexes, supplement 183
[NASA-SP-7011[183]] N78-31712

**AEROSPACE SYSTEMS**

Proceedings of AFOSR/AFML Corrosion Workshop
[AD-A055281] N78-31218

**AGRICULTURE**

Assessment of the damage caused by the frost of 1975 to coffee and wheat crops in the northwest of the state of Parana using LANDSAT images with automatic classification
[E78-10193] N78-31492

AGRESTE project: Agricultural resources investigations in northern Italy and southern France
[E78-10199] N78-31497

A summary of the users perspective of LANDSAT-D and reference document of LANDSAT users
[E78-10208] N78-31506

Energy analysis and model of intermediate agriculture
N78-31571

Alternative policies for controlling nonpoint agricultural sources of water pollution
[PB-280757/6] N78-31623

**AIR**

High performance metal/air fuel cells. Part 1: General review
[UCID-17558-PT-1] N78-31549

**AIR CONDITIONING**

JPL Energy Consumption Program [ECP] documentation: A computer model simulating, heating, cooling and energy loads in buildings --- low cost solar array efficiency
[NASA-CR-157599] N78-31541

**AIR DROP OPERATIONS**

Hybrid trajectory simulation of a parachute system --- low impact velocity two parachute system aerodynamics
[SAND-78-8668] N78-31054

**AIR FILTERS**

Development of a portable device to collect sulfuric acid aerosol
[PB-280048/0] N78-31603

**AIR LAND INTERACTIONS**

Energy quality of humidity and thermal advection of air in Florida
N78-31567

**AIR POLLUTION**

Use of a semiconductor laser in infrared spectroscopy --- air pollution monitoring
[IS-T-786] N78-31196

Coal desulfurization process
[NASA-CASE-NPO-13937-1] N78-31527

Effect of inlet temperature on the performance of a catalytic reactor --- air pollution control
[NASA-TM-78977] N78-31534

Experimental investigation of the marine boundary layer in support of air pollution studies in the Los Angeles air basin
[AD-A054239] N78-31592

Mechanisms of exhaust pollutants and plume formation in continuous combustion
[AD-A054844] N78-31594

Outdoor sources of indoor air pollution
[BNL-50762] N78-31595

Flue gas desulfurization systems: Design and operating considerations. Volume 1: Executive summary
[PB-280253/6] N78-31598

Flue gas desulfurization systems: Design and operating considerations. Volume 2: Technical report
[PB-280254/4] N78-31599

Nitrogen dioxide photolytic, radiometric, and meteorological field data
[PB-279999/7] N78-31604

Reaction rate and photochemical data for atmospheric chemistry, 1977
[NASA-CR-157610] N78-31607

Cleaning coal with coal: Coal humic acids for removal of acids, alkali, salinity, and heavy metal pollutants associated with the use of coal as a fuel
[PB-280580/2] N78-31608

Pollutant measurements in plumes from power plants and cities: A project MISTT report, summer 1975, February 1976, and February 1977
[PB-280198/3] N78-31609

Improved temperature stability of sulfur dioxide samples collected by the federal reference method
[PB-279873/4] N78-31610

Organic characterization of aerosols and vapor phase compounds in urban atmospheres
[PB-280050/6] N78-31611

Control techniques for nitrogen oxides emissions from stationary sources - second edition
[PB-280034/0] N78-31612

Development and fabrication of a prototype Fibrous Aerosol Monitor [FAM]
[PB-280126/4] N78-31613

Procedures for quantifying relationships between photochemical oxidants and precursors: Supporting documentation
[PB-280058/9] N78-31614

Burner design criteria for NOx control from low-BTU gas combustion: Volume 2. Elevated fuel temperature
[PB-280199/1] N78-31615

Aircraft air pollution, volume 3. A bibliography with abstracts
[NTIS/PS-78/0623/5] N78-31618

Physical and chemical phenomena responsible for odor formation in diesel engines
[PB-280544/8] N78-31621

Regulations and resource file of continuous monitoring information
[PB-280975/4] N78-31625

The role of technological and lay-out factors, as well as climate, in formation of the air basin in the region of chemical plants
N78-31700

On the question of rapidly setting hygienic standards for industrial substances with irritant action
N78-31701

Physiological response to atmospheric pollutants
[PB-280413/6] N78-31731

**AIR QUALITY**

Air quality data: 1977 first quarter statistics
[PB-280184/3] N78-31600

Air quality data: 1977 second quarter statistics
[PB-280185/0] N78-31601

Air quality data: 1976 fourth quarter statistics
[PB-280186/8] N78-31602

Air quality criteria for lead
[PB-280411/0] N78-31730

**AIR SAMPLING**

Atmospheric pathways of the phosphorus cycle
N78-31590

The analysis of ambient air using atmospheric pressure chemical ionization mass spectrometry
[UTIAS-219] N78-31591

Air quality data: 1977 first quarter statistics
[PB-280184/3] N78-31600

Air quality data: 1977 second quarter statistics
[PB-280185/0] N78-31601

Air quality data: 1976 fourth quarter statistics
[PB-280186/8] N78-31602

Regulations and resource file of continuous monitoring information
[PB-280975/4] N78-31625

**AIR TO AIR MISSILES**

An extended Kalman filter fire control system against air-to-air missiles volume 1
[AD-A055179] N78-31090

**AIR TRAFFIC CONTROL**

IFR aircraft handled forecast by air route traffic control center, fiscal years 1978-1989
[AD-A049305] N78-31075

Future needs and opportunities in the air traffic control system
[GPO-98-931] N78-31076

Some important results obtained in the analysis of near midair and midair collisions
[DLR-FB-77-25] N78-31081

Parameters of future ATC systems relating to airport capacity/delay
[AD-A055482] N78-31130

Dulles control tower console design study
[AD-A056200] N78-31132

Experimental test plan for the evaluation of aircraft separation assurance displays using airline flight simulators
[AD-A055849] N78-31134

Test and evaluation of air/ground communications antennas
[AD-A056148] N78-31325

Large scale information systems, volume 1
[AD-A054942] N78-31950

**AIR TRAFFIC CONTROLLERS [PERSONNEL]**

Methods to assess work load
[AGARD-CP-216] N78-31745

Determination of stress and strain of air traffic control officers --- physiological response measurements
N78-31751

Instruments and methodology for the assessment of physiological cost of performance of stressful continuous operations: The air traffic services tower environment
N78-31752

Neurophysiological assessment of functional states of the brain --- electroencephalographic responses to workloads
N78-31755

**AIR WATER INTERACTIONS**

An introduction to turbulence in geophysics and air-sea interactions
[AGARD-AG-232] N78-31661

**AIRBORNE EQUIPMENT**

Synthetic Aperture Radar [SAR] system limitations due to phase errors
[DLR-IB-551-77/2] N78-31349

**AIRCRAFT ACCIDENT INVESTIGATION**

Preliminary design of an accident Information Retrieval System [AIRS]
[AD-A055590] N78-31952

**AIRCRAFT ANTENNAS**

Test and evaluation of air/ground communications antennas
[AD-A056148] N78-31325

Analysis of monopole antenna arrays on cylinders by the geometrical theory of diffraction
[AD-A055197] N78-31335

**AIRCRAFT APPROACH SPACING**

Parameters of future ATC systems relating to airport capacity/delay
[AD-A055482] N78-31130

**AIRCRAFT CARRIERS**

The influence of throttle augmented stability [APCS] and short period control characteristics on the landing approach
[AD-A055892] N78-31123

**AIRCRAFT CONSTRUCTION MATERIALS**

Material evaluation of polyurethane foam, 0.05 g/cm3 density
[BDX-613-1836-REV] N78-31249

**AIRCRAFT DESIGN**

Graphics for the hybrid stores separation simulation of the B77 system
[SAND-78-8212] N78-31099

**AIRCRAFT ENGINES**

Turbine engine rotordynamic evaluation, volume 1
[AD-A055262] N78-31111

Aircraft air pollution, volume 3. A bibliography with abstracts
[NTIS/PS-78/0623/5] N78-31618

**AIRCRAFT EQUIPMENT**

Modified helicopter icing spray system evaluation
[AD-A055039] N78-31091

Statistical review of counting accelerometer data for Navy and Marine fleet aircraft from 1 Jan. 1962 to 31 Dec. 1977
[AD-A055672] N78-31098

Display size and target acquisition perforance
[AD-A054624] N78-31741

**AIRCRAFT FUEL SYSTEMS**

Study of fuel systems for LH2-fueled subsonic transport aircraft, volume 1
[NASA-CR-145369-VOL-1] N78-31085

Study of fuel systems for LH2-fueled subsonic transport aircraft, volume 2
[NASA-CR-145369-VOL-2] N78-31086

**AIRCRAFT HAZARDS**

Simultaneous measurements of ozone outside and inside cabins of two B-747 airliners and a Gates Learjet business jet
[NASA-TM-78983] N78-31061

Gust front analytical study
[AD-A056151] N78-31669

**AIRCRAFT INSTRUMENTS**

Use of eye-movement measures to establish design parameters for helicopter instrument panels
N78-31748

**AIRCRAFT LANDING**

TRSB microwave landing system demonstration program at John F. Kennedy International Airport, Long Island, New York, USA
[AD-A055447] N78-31070

The influence of throttle augmented stability [APCS] and short period control characteristics on the landing approach
[AD-A055892] N78-31123

**AIRCRAFT LAUNCHING DEVICES**

Maximum likelihood identification of the longitudinal aerodynamic coefficients of the EA-6B airplane in the catapult launch configuration
[AD-A054243] N78-31046

**AIRCRAFT NOISE**

Community noise exposure resulting from aircraft operations. Volume 5: Acoustic data on Air Force propeller aircraft
[AD-A055079] N78-31593

The influence of background noise level and signal duration on the judged annoyance of aircraft noise
[UTIAS-228] N78-31875

Experimental investigation of outdoor propagation of finite-amplitude noise --- aircraft noise
[NASA-CR-2992] N78-31876

**AIRCRAFT PERFORMANCE**

Effects of dynamic aeroelasticity on handling qualities and pilot rating
N78-31084

**AIRCRAFT SAFETY**

Hazard assessment of aircraft gun compartments
[AD-A055026] N78-31064

**AIRCRAFT STRUCTURES**

A study of analog programming for prediction of crack growth in aircraft structures subjected to random loads
[AD-A055789] N78-31097

Estimated costs of extended low-rate airframe production
[AD-A054834] N78-31100

The influence of the environment on the elastoplastic properties of adhesives in metal bonded joints --- in aircraft structures
[DLR-FB-77-63] N78-31251

Environmental effects on fatigue of aluminium and titanium alloys
[NLR-MP-77019-U] N78-31463

**AIRCRAFT SURVIVABILITY**
Computerized aircraft attrition program
[AD-A055784] N78-31094
**AIRFOILS**
Two-dimensional subsonic wiad tunnel evaluation of two related cambered 15-percent thick circulation control airfoils
[AD-A055140] N78-31047
The design and aerodynamic characteristics of the RAE 5215 aerofoil
[ARC-CP-1386] N78-31055
**AIRFRAME MATERIALS**
Effects of environment, and damping and coupling properties of composite laminates on panel flutter --- airframe materials
[AD-A055753] N78-31175
**AIRFRAMES**
Estimated costs of extended low-rate airframe production
[AD-A054834] N78-31100
Engine/airframe/drive train dynamic interface documentation
[AD-A055766] N78-31114
**AIRLINE OPERATIONS**
IFR aircraft handled forecast by air route traffic control center, fiscal years 1978-1989
[AD-A049305] N78-31075
Analysis of runway occupancy times at major airports
[AD-A056052] N78-31131
**AIRPORT TOWERS**
Dulles control tower console design study
[AD-A056200] N78-31132
**AIRPORTS**
TRSB microwave landing system demonstration program at Kristiansand, Norway
[AD-A055317] N78-31071
TRSB microwave landing system demonstration program at Charleroi, Belgium
[AD-A055920] N78-31072
Parameters of future ATC systems relating to airport capacity/delay
[AD-A055482] N78-31130
Analysis of runway occupancy times at major airports
[AD-A056052] N78-31131
**ALFALFA**
Atlas of selected crop spectra, Imperial Valley, California
[E78-10201] N78-31499
**ALGEBRA**
Algebraic simplification of interconnected systems
[UCID-17760] N78-31843
**ALGORITHMS**
Performance in a jamming environment of a low-cost GRS user receiver algorithm for aiding a tactical INS
[AD-A055239] N78-31078
Theoretical and experimental investigation of computation errors in two different strapdown inertial navigation [IN]-systems
[FOA-C-20217-E4] N78-31080
Development and application of a SAW Chirp-Z transformer
N78-31311
An algorithm for determining speech intelligibility
[AD-A055236] N78-31329
Topics in computational geometry
N78-31783
Syntactic algorithms for image segmentation and a special computer architecture for image processing
N78-31785
An adaptive recognition algorithm for the automatic detection of straight line segments
N78-31787
Programming by abstracts demonstration
N78-31788
A machine independent algorithm for code generation and its use in retargetable compilers
N78-31789
Numerical algorithms for nonlinearly constrained optimization
N78-31790
Software tool [S] for evaluating the effects of finite wordlength
[AD-A055777] N78-31806
Implementation of algorithms for performance analysis of a class of multiprogrammed computers
[FUB-25-1977] N78-31811
On the dual-adaptive control and its practical applications
[CEPHAG-52/77] N78-31832
An alternating direction implicit method for the Control Data STAR-100 vector computer
[NASA-TP-1282] N78-31836
Degeneracy in special purpose primal algorithms used in obtaining least absolute value estimators
[AD-A055042] N78-31838
Symmetry, automorphism and test
[CEPHAG-46/77] N78-31844
The development of quasi-Newton methods for unconstrained minimisation --- of nonlinear functions
[RAE-TR-77132] N78-31845
The simplex SON algorithm for LP/embedded network problems
[AD-A055156] N78-31863
Analysis of a cooperative stereo algorithm
[AD-A055099] N78-31899
**ALKALINE EARTH METALS**
Nonlinear spectroscopy
[AD-A055076] N78-31186
Inhibition of hot salt corrosion by metallic additives
[NASA-TM-78966] N78-31208
**ALL-WEATHER AIR NAVIGATION**
Visual workload of the copilot/navigator during terrain flight
[AD-A055038] N78-31742
**ALLERGIC DISEASES**
Strong sensitizers
[PB-280475/5] N78-31728
**ALLOYS**
Survey and analysis of selected topics within the Energy Research and Development Administration's [ERDA] materials research and development programs
[DOE/ET-0006] N78-31170
Effects of thermomechanical processing on strength and toughness of iron - 12-percent-nickel - reactive metal alloys at -196 C
[NASA-TP-1308] N78-31213
The role of passive film growth kinetics and properties in stress corrosion and crevice corrosion susceptibility
[AD-A055366] N78-31219
Cyclic ductility cyclic strength and fatigue crack propagation of metals and alloys
[AD-A055359] N78-31220
An analysis of metallic glasses by Mossbauer spectroscopy
[AD-A055073] N78-31241
Alloys for the fusion reactor environment: A technical assessment
[DOE/ET-0007] N78-31908
**ALPHANUMERIC CHARACTERS**
Computer science and technology: FORTRAN 4 enhanced character graphics
[PB-279939/3] N78-31772
**ALTERNATING CURRENT**
Possibility of attenuating the ecological effects of alternating current power lines as a result of new designs and circuit changes
N78-31708
**ALTIMETERS**
The geoid spectrum from altimetry
[NASA-TM-79583] N78-31633
**ALUM**
Effects of diversion and alum application on two eutrophic lakes
[PB-280983/8] N78-31624
Effects of water-treatment-plant wastes on domestic wastewater treatment processes --- alum sludge disposal
[PB-280970/5] N78-31968
**ALUMINUM**
Fabrication of graphite-aluminum composites via pultrusion
[AD-A055257] N78-31173
Measurements of material properties for solar cells --- aluminum film and KAPTON
[NASA-CR-150797] N78-31531
**ALUMINUM ALLOYS**
Correlation of low-cycle and high-cycle fatigue data for solution-annealed Incoloy-800
[BNL-NUREG-23776] N78-31222
Constant-amplitude and program-load fatigue tests at low cyclic frequencies on thick aluminium alloy pin joints
[ARL-STRUC-REPT-365] N78-31457
Residual strength tests on fatigue-cracked multi-fastener specimens of extruded L.65 aluminum alloy
[ARL-STRUC-NOTE-444] N78-31458
Environmental effects on fatigue of aluminium and titanium alloys
[NLR-MP-77019-U] N78-31463
Impact of rock debris on a simply supported beam
[AD-A055077] N78-31467
An interactive program for the analysis of fatigue data
N78-31476
**ALUMINUM NITRIDES**
Research on aluminum nitride materials
[AD-A054980] N78-31930
**ALUMINUM OXIDES**
Fabrication and mechanical properties of alumina fiber-alumina matrix composites
N78-31171
Radiation effects on MOS/SOS semiconductor devices --- defects in aluminum oxide crystals
[AD-A055925] N78-31934
**AMAZON REGION [SOUTH AMERICA]**
Collected summaries of works dealing with the application of LANDSAT imagery in the survey of mineral resources
[E78-10191] N78-31490
Use of LANDSAT data to monitor pasture project in Amazonia
[E78-10192] N78-31491
**AMINO ACIDS**
Unusual magnetic properties in two copper [II] chelates of Schiff bases derived from alpha-amino acids: A dimeric interaction in a structural linear chain
[AD-A055101] N78-31168
**AMORPHOUS MATERIALS**
An analysis of metallic glasses by Mossbauer spectroscopy
[AD-A055073] N78-31241
**AMPLITUDE MODULATION**
Two FORTRAN programs for calculating global ionospheric amplitude and phase scintillation
[AD-A055273] N78-31641
**ANALOG CIRCUITS**
Digital controller design: Analysis of the annular suspension pointing system --- analog controllers with feedback
[NASA-CR-150807] N78-31825
**ANALOG COMPUTERS**
A study of analog programming for prediction of crack growth in aircraft structures subjected to random loads
[AD-A055789] N78-31097
**ANALYSIS [MATHEMATICS]**
Resonant scattering of electromagnetic radiation from non-spherical optically anisotropic targets with axial symmetry
N78-31322
Marx bank and magnetron circuit model
[UCID-17747] N78-31371
Risk analysis in environmental studies. 1: Risk analysis methodology, a statistical approach. 2: Data management for environmental studies
[RHO-SA-33] N78-31597
Topics in computational geometry
N78-31783
**ANALYSIS OF VARIANCE**
Effect of handling procedures on sample quality --- organic compounds
[PB-279910/4] N78-31204
**ANGLE OF ATTACK**
Initial investigation of stationary hydrofoil cavitation and cavitation noise scaling
[AD-A055260] N78-31271
**ANISOTROPY**
Effects of pressure anisotropy on the stability of the guiding center plasma
[ORO-5260-1] N78-31907
Electron scattering rate anisotropy and conduction electron-4f moment interactions Au[rare earth] dilute alloys
N78-31920
**ANNEALING**
Infrared studies of the solid state polymerization of diacetylene monomers
[AD-A055988] N78-31244
**ANTARCTIC REGIONS**
A comparison between derived internal dielectric properties and radio-echo sounding records of the ice sheet at Cape Folger, Antarctica
[AD-A055245] N78-31538
Observations of the Antarctic polar front by a moored array during FDRAKE-76
[PB-281460/6] N78-31686
**ANTENNA ARRAYS**
Analysis of monopole antenna arrays on cylinders by the geometrical theory of diffraction
[AD-A055197] N78-31335
UHF adaptive array development program
[AD-A055942] N78-31339
**ANTENNA DESIGN**
Nodding feed antenna for communications with satellites in sychronous orbit
[NASA-TM-78989] N78-31155
**ANTENNA FEEDS**
Reflex feed system for dual frequency antenna with frequency cutoff means
[NASA-CASE-NPO-14022-1] N78-31321
**ANTENNAS**
Noise measurements of an aluminum gravitational radiation antenna at 5 to 9 Kelvin
N78-31320
**ANTIDOTES**
Behavior, ecology and toxicity of venomous marine fishes
[AD-A054925] N78-31692
**ANTIREFLECTION COATINGS**
High output solar cell with multilayer AR coating
[AD-A054226] N78-31545
**APOLLO SOYUZ TEST PROJECT**
Analytical study of electrophoretic characterization of kidney cells --- conducted during the Apollo Soyuz Test Project
[NASA-CR-150790] N78-31713
**APOLLO SPACECRAFT**
Crustal evolution inferred from Apollo magnetic measurements
[NASA-TM-78524] N78-32029
**APPROACH CONTROL**
The influence of throttle augmented stability [APCS] and short period control characteristics on the landing approach
[AD-A055892] N78-31123

**APPROXIMATION**
New approximation equations for the saturation pressure of water vapor and for humidity parameters used in meteorology
[DLR-FB-77-52] N78-31679
Scheme-independent stability criteria for difference approximations of hyperbolic initial-boundary value problems, 1
[AD-A055022] N78-31839

**ARCHITECTURE [COMPUTERS]**
A new loop structure for distributed microcomputing systems
N78-31760
Design and implementation of an adaptable compiler for minicomputer type architecture
N78-31761
Syntactic algorithms for image segmentation and a special computer architecture for image processing
N78-31785
HOL code generator development methodology
[AD-A055383] N78-31804
A fault-tolerant multiprocessor architecture for aircraft, volume 1 --- autopilot configuration
[NASA-CR-3010] N78-31818
Computer science and technology: Local area networking. Report of a workshop
[PB-279921/1] N78-31823

**ARGON**
Activated gas reactions with silicone and epoxy resins
[SAND-77-1429C] N78-31201

**AROMATIC COMPOUNDS**
Polymeric foams from cross-linkable poly-n-ary lenebenzimidazoles
[NASA-CASE-ARC-11008-1] N78-31232

**ARRAYS**
Signal Processing with a Reflective Dot Array [RDA]
N78-31285

**ARRHYTHMIA**
Description and analysis of the Hewlett-Packard 78220 arrhythmia monitoring system
[AD-A055451] N78-31720

**ARTIFICIAL INTELLIGENCE**
Mechanical theorem proving and artificial intelligence languages
N78-31781
Truth maintenance systems for problem solving
[AD-A054826] N78-31799

**ARTIFICIAL SATELLITES**
Design, fabrication and testing of a CFA for use in the solar power satellite
[NASA-CR-159410] N78-31143
Structured analysis and design of a satellite simulator
[AD-A055192] N78-31150

**ASSEMBLIES**
Tracking servobridge detectors. Volume 3: Operation sheets
[AD-A055085] N78-31358

**ASSEMBLY LANGUAGE**
Simulation of the direct execution of a higher order language
[AD-A055235] N78-31798

**ASSESSMENTS**
Methods to assess work load
[AGARD-CP-216] N78-31745

**ASSOCIATIVE PROCESSING [COMPUTERS]**
On the epistemological status of semantic networks
[AD-A055048] N78-31337
SPAR data handling utilities
[NASA-TM-78701] N78-31793

**ASTROMETRY**
Astrometry satellite. Theoretical study of the accuracy. Volume 1: Models and algorithms
[ESA-CR[P]-1068-VOL-1] N78-32024

**ASTRONAUT PERFORMANCE**
Spacesuit mobility joints
[NASA-CASE-ARC-11058-1] N78-31735

**ASTRONAUTS**
Astronauts and cosmonauts biographical and statistical data, revised 31 May 1978
[GPO-30-531] N78-32035

**ASTRONOMICAL CATALOGS**
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 1: Selected areas 51, 54, 57, 82, 107
N78-32021
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 2: Selected areas 71, 94, 141; M3, M13, NGC4147
N78-32022
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 3: Milky way fields Perseus 1, NGC 1664, M 37 1, M 37 2, NGC 6067, Sagittarius 1
N78-32023

**ASTRONOMICAL OBSERVATORIES**
The gamma ray observatory
N78-32013

**ASTRONOMICAL SPECTROSCOPY**
Gamma ray spectroscopy in astrophysics --- conferences
[NASA-TM-79619] N78-31971
Gamma ray spectroscopy in astrophysics: An observational overview [50 keV-20 MeV]
N78-31973
Planetary gamma-ray spectroscopy
N78-31976
The galactic gamma-ray flux in the 0.06 to 5 MeV range
N78-31979
Observational evidence for extraterrestrial gamma-ray line sources
N78-31983
Gamma-ray lines form neutron stars as probes of fundamental physics
N78-31985
Galactic center iron line emission
N78-31987
Gamma line radiation from supernovae --- nucleosynthesis
N78-31988
Gamma ray lines from novae --- stellar mass ejection
N78-31989
Gamma-ray line emission above 8 MeV
N78-31990
Cyclotron lines form Her X-1
N78-31991
Confidence about line features in Her X-1 spectrum
N78-31992
Upper limits on the cyclotron lines from Her X-1 as observed with OSO-8
N78-31993
HEAO-1 observations of Her X-1 at energies above 13 keV
N78-31994
The excitation of electronic transverse energy levels in an intense magnetic field
N78-31996
Gamma ray spectroscopy in astrophysics: Future role of scintillation detectors
N78-31999
Background of a shielded Ge[Li] spectrometer at balloon altitudes
N78-32001
Radiation damage of germanium detectors
N78-32002
Gamma ray polarimetry --- compton scattering and pair production
[CONTRIB-156] N78-32004
Future directions in experimental gamma ray astronomy --- technology assessment
N78-32005
The ISEE-C gamma ray burst spectrometer
N78-32009
High resolution spectroscopy from low altitude satellites --- gamma ray astronomy
N78-32010
HEAO C-1 gamma-ray spectrometer --- experimental design
N78-32011
Gamma ray spectroscopy in astrophysics: Solar gamma ray astronomy on solar maximum mission --- experimental design
N78-32012

**ASTRONOMICAL TELESCOPES**
Low energy gamma ray observations with the MPI-Compton telescope --- balloon-borne detectors
N78-31980
Calibration and positional determination of Boller and Chivens 31-inch telescope B
[AD-A055266] N78-32020

**ASTRONOMY**
Definition study of a multidisciplinary European mission. Volume 1: Executive summary
[ESS/SS-777] N78-31138
Astrometry satellite. Theoretical study of the accuracy. Volume 2: Numerical experiments
[ESA-CR[P]-1068-VOL-2] N78-32025

**ASTROPHYSICS**
Gamma ray spectroscopy in astrophysics --- conferences
[NASA-TM-79619] N78-31971
Mechanisms and sites for astrophysical gamma ray line production
N78-31972
Gamma ray spectroscopy in astrophysics: An observational overview [50 keV-20 MeV]
N78-31973
X-ray observations of BL Lac objects
[NASA-TM-79625] N78-32016

**ATMOSPHERIC ATTENUATION**
The development and application of new experimental laboratory techniques and equipment for measuring laser energy attenuation in the atmosphere
[AD-A055082] N78-31415
Experimental investigation of outdoor propagation of finite-amplitude noise --- aircraft noise
[NASA-CR-2992] N78-31876

**ATMOSPHERIC BOUNDARY LAYER**
Simulation of the urban neutral boundary layer for the model study of wind loads on tall buildings
[PB-280787/3] N78-31278
Experimental investigation of the marine boundary layer in support of air pollution studies in the Los Angeles air basin
[AD-A054239] N78-31592
Development of a three-dimensional model of the atmospheric boundary layer using the finite element method
[UCRL-52366] N78-31652

**ATMOSPHERIC CHEMISTRY**
Reaction rate and photochemical data for atmospheric chemistry, 1977
[NASA-CR-157610] N78-31607
Reaction rate data, number 61
[AD-A055983] N78-31644

**ATMOSPHERIC CIRCULATION**
A model for the atmospherically forced circulation in an ocean basin
N78-31680

**ATMOSPHERIC COMPOSITION**
Simultaneous measurements of ozone outside and inside cabins of two B-747 airliners and a Gates Learjet business jet
[NASA-TM-78983] N78-31061
Atmospheric pathways of the phosphorus cycle
N78-31590
Organic characterization of aerosols and vapor phase compounds in urban atmospheres
[PB-280050/6] N78-31611
Atmospheric conditions at the High Energy Laser Systems Test Facility [HELSTF], White Sands Missile Range, New Mexico 24 March to 8 April 1977
[AD-A055028] N78-31671

**ATMOSPHERIC DENSITY**
Measurements of atmospheric density at Kwajalein Atoll, 18 May 1977
[AD-A054784] N78-31640
Atmospheric density measurement in the middle atmosphere --- betasonde
[AD-A055773] N78-31646

**ATMOSPHERIC ENTRY SIMULATION**
Climate simulation
[AD-A055857] N78-31672

**ATMOSPHERIC MODELS**
Development of a three-dimensional model of the atmospheric boundary layer using the finite element method
[UCRL-52366] N78-31652
Monthly mean simulation experiments with a course-mesh global atmospheric model
[NASA-CR-157574] N78-31662
Gust front analytical study
[AD-A056151] N78-31669

**ATMOSPHERIC MOISTURE**
Instruments for measuring the amount of moisture in the air
[NASA-TM-78190] N78-31405
Energy quality of humidity and thermal advection of air in Florida
N78-31567

**ATMOSPHERIC PHYSICS**
Definition study of a multidisciplinary European mission. Volume 1: Executive summary
[ESS/SS-777] N78-31138

**ATMOSPHERIC PRESSURE**
The analysis of ambient air using atmospheric pressure chemical ionization mass spectrometry
[UTIAS-219] N78-31591

**ATMOSPHERIC REFRACTION**
Backus-Gilbert inversion of electromagnetic propagation phenomena for remote probing of the atmosphere
[DLR-IB-551-76/21] N78-31346

**ATMOSPHERIC TEMPERATURE**
The GISS sounding temperature impact test
[NASA-TM-78063] N78-31667

**ATMOSPHERIC TURBULENCE**
An introduction to turbulence in geophysics and air-sea interactions
[AGARD-AG-232] N78-31661

**ATMOSPHERICS**
A random point process model for atmospheric radio noises
[AD-A055123] N78-31326
Performance analysis of continuous-phase frequency shift keying modulation in atmospheric noise
[AD-A055194] N78-31327
Evaluation of coherent FSK performance in atmospheric radio noise
[AD-A055237] N78-31330
Weather modification
[GPO-20-025] N78-31666

**ATOM CONCENTRATION**
Determination of low-level mercury by cold vapor generation and atomic absorption spectroscopy
[ARH-LD-160] N78-31203

**ATOMIC SPECTRA**
Nonlinear spectroscopy
[AD-A055076] N78-31186
Summary of work on cooled ion frequency standard
[AD-A054234] N78-31880

**ATOMIC STRUCTURE**
Structure of gain boundaries in silicon nitride based alloys --- electron microscopy of MgO, Y2O3, and magnesium-sialon
[LBL-6985] N78-31177
Surface and bulk electronic properties of d-band perovskites
N78-31916

**ATS 1**
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 1
[NASA-CR-135416-VOL-1] N78-31141
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 2 --- bibliography
[NASA-CR-135416-VOL-2] N78-31142

**ATS 3**
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 2 --- bibliography
[NASA-CR-135416-VOL-2] N78-31142

**ATS 5**
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 1
[NASA-CR-135416-VOL-1] N78-31141
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 2 --- bibliography
[NASA-CR-135416-VOL-2] N78-31142

**ATS 6**
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 1
[NASA-CR-135416-VOL-1] N78-31141
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 2 --- bibliography
[NASA-CR-135416-VOL-2] N78-31142

**ATTITUDE CONTROL**
Theoretical and experimental methods in the solution of missile nonlinear roll problems
[AD-A055718] N78-31152

**AUDIO FREQUENCIES**
Pitch and formant analysis of the voice in the investigation of pilot workshop
N78-31750

**AUDITORY TASKS**
Auditory communication and workload --- human response time measurements to voice communication
N78-31749

**AUGER SPECTROSCOPY**
Direct observation of grain boundary diffusion by scanning Auger microscopy --- scanning electron microscopy of metal films
[COO-2679-14] N78-31935

**AUSTENITE**
Engineering design data and correlations for nitinol devices --- austenitic martensitic phase transformations
N78-31206
Mechanical stability of retained austenite in tempered 9Ni steel
[AD-A055240] N78-31217

**AUSTENITIC STAINLESS STEELS**
Development of ultrasonic examination methods for austenitic stainless steel weld inspection
[HEDL-SA-1348] N78-31445

**AUTOMATIC FLIGHT CONTROL**
Control system design using vector-valued performance criteria with application to the control rate reduction in parameter insensitive control systems
[DLR-FB-77-55] N78-31125
A fault-tolerant multiprocessor architecture for aircraft, volume 1 --- autopilot configuration
[NASA-CR-3010] N78-31818

**AUTOMATIC TEST EQUIPMENT**
Two-crystal soft X-ray spectrometer
N78-31402

**AUTOMOBILE ENGINES**
Automotive technology status and projections. Volume 1: Executive summary
[NASA-CR-157593] N78-31428
Automotive technology status and projections. Volume 2: Assessment report
[NASA-CR-157594] N78-31429
Automotive diesel technology program --- computerized design
[SAN-1099-1] N78-31436
The outlook for automotive fuel supplies, alternative vehicle engines, and potential implications for transportation tax structures [1985-2000]
[PB-279679/5] N78-31440
Initial test results with a single-cylinder rhombic-drive Stirling engine --- to be applied to automobile engine design to conserve energy
[NASA-TM-78919] N78-31533

**AUTOMOBILES**
Automotive technology status and projections. Volume 1: Executive summary
[NASA-CR-157593] N78-31428
Automotive technology status and projections. Volume 2: Assessment report
[NASA-CR-157594] N78-31429
Research safety vehicle. Phase 2, volume 2: Comprehensive technical results
[PB-280153/8] N78-31441
Research safety vehicle. Phase 2, volume 3A: Subcontractor reports: The Budd Company, Man Factors, Inc., Mard Analysis Corporation, Monsanto Research Corporation
[PB-280154/6] N78-31442
Research safety vehicle. Phase 2, volume 3B: Subcontractor reports. RCA Laboratories, Stanford Research Institute, System Technology, Inc., University of Utah
[PB-280155/3] N78-31443
Organic emissions from automobile interiors --- indoor air pollution
[PB-280374/0] N78-31605

**AUTOMORPHISMS**
Symmetry, automorphism and test
[CEPHAG-46/77] N78-31844

**AVIONICS**
Program analyses for the S-3 weapon system improvement program
[AD-A055887] N78-31093
AFAL simulation facility/capability manual. Volume 1: Executive summary and Systems Avionics Division
[AD-A055591] N78-31102
A modular adaptive, variable function flight control sensor
[AD-A055175] N78-31120
The human operator simulator: Workload estimation using a simulated secondary task
N78-31756
Aeronautics and space report of the President: The 1977 activities
N78-32015

**AXIAL FLOW**
A theoretical study of the performance of a number of different axial-flow turbine configurations under conditions of pulsating flow
[ARL-MECH-ENG-REPT-149] N78-31104
Boundary-layer and inverse potential flow methods for axisymmetric bodies
[AD-A054759] N78-31387
Axial field limitations in MHD generators
N78-31905

**AXIAL FLOW PUMPS**
Liquid rocket engine axial-flow turbopumps
[NASA-SP-8125] N78-31164

**AXIAL FLOW TURBINES**
Analysis of multistage, axial flow turbomachine wake production, transport, and interaction
[AD-A055754] N78-31118

**AXIAL LOADS**
Determination of fatigue performance data on structural materials under typified random loading: Axially loaded notched specimens of mild steel RR St 52 - 3 [SAE 1030]
[TB-127(1978)] N78-31461

**AXISYMMETRIC BODIES**
Development of a computer program to calculate aerodynamic characteristics of bodies and wing-body combinations --- surface pressure distribution in supersonic flow
[AD-A055846] N78-31053

**AXISYMMETRIC FLOW**
Laminar flow-field computation in axisymmetric nozzles
[RAE-TR-77175] N78-31059
Analysis of multistage, axial flow turbomachine wake production, transport, and interaction
[AD-A055754] N78-31118


## B


**BACKGROUND NOISE**
The influence of background noise level and signal duration on the judged annoyance of aircraft noise
[UTIAS-228] N78-31875

**BACKGROUND RADIATION**
Atmospheric CO2 infrared background investigation. Experimental configuration of 2.7 to 4.3 micrometers fluorescence modeling of 4.3 micrometers spectral structure
[AD-A055943] N78-31643
Background of a shielded Ge[Li] spectrometer at balloon altitudes
N78-32001

**BACKSCATTERING**
On the relative location of the plasmapause and the HF backscatter curtains
[REPT-23] N78-31636

**BACKUPS**
Backup control for a variable cycle engine --- fighter aircraft
[AD-A055658] N78-31116

**BAFFLES**
Diffraction effects of baffles on acoustic directivity patterns
N78-31869

**BALLISTIC TRAJECTORIES**
Aeroballistics of corkscrew projectiles
[AD-A054735] N78-31049

**BALLISTICS**
A technique for evaluating fuel and hydraulic fluid ballistic vulnerability
[AD-A055058] N78-31188
Propellant reassessment program
[AD-A055976] N78-31264

**BALLOON FLIGHT**
Measurement of 200-400 nm solar UV fluxes at altitudes up to 39 km on the Stratcom 7-A balloon flight
[AD-A055774] N78-32033

**BALLOON-BORNE INSTRUMENTS**
Low energy gamma ray observations with the MPI-Compton telescope --- balloon-borne detectors
N78-31980

**BAND STRUCTURE OF SOLIDS**
Surface and bulk electronic properties of d-band perovskites
N78-31916

**BANDPASS FILTERS**
Transient response of filters
[AD-A055324] N78-31366

**BANDWIDTH**
Development of a 100MHz bandwidth pulse compression subsystem for airborne application
N78-31284
A wide bandwidth CCD buffer memory system
N78-31291
Charge Injection Device [CID] Hadamard plane processor for image bandwidth compression
N78-31309

**BARIUM ION CLOUDS**
Ion cloud modeling
[AD-A055969] N78-31648

**BARLEY**
Heat capacity mapping mission
[E78-10196] N78-31494

**BARRIER LAYERS**
Electron tunneling into the A15 superconductors: Nb3Sn, V3Si, and Nb3Ge
N78-31924

**BASALT**
Cobalt as an analogue for iron in high temperature experiments on basaltic compositions
N78-31629

**BEAMS [SUPPORTS]**
On the multiplicity of solutions of the inverse problem for a vibrating beam
[NASA-CR-157572] N78-31466
Impact of rock debris on a simply supported beam
[AD-A055077] N78-31467
Transverse compressional damping in the vibratory response of elastic-viscoelastic-elastic beams
[AD-A054769] N78-31468
Hardboard-webbed I-beams: Effects of long-term loading and loading environment
[AD-A055006] N78-31469

**BELGIUM**
TRSB microwave landing system demonstration program at Charleroi, Belgium
[AD-A055920] N78-31072

**BETA PARTICLES**
Atmospheric density measurement in the middle atmosphere --- betasonde
[AD-A055773] N78-31646

**BIAS**
Bias in the estimates of treatment effects in quasi-experimental evaluations
[PB-280060/5] N78-31861

**BIBLIOGRAPHIES**
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[NTIS/PS-78/0527/8] N78-31274
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[NTIS/PS-78/0579/9] N78-31377
Microwave electric power transmission. A bibliography with abstracts
[NTIS/PS-78/0580/7] N78-31379
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[NTIS/PS-78/0516/1] N78-31424
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[NTIS/PS-78/0568/2] N78-31451

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[NTIS/PS-78/0565/8] N78-31452
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[NTIS/PS-78/0566/6] N78-31453
Earth resources: A continuing bibliography with indexes, issue 18
[NASA-SP-7041[18]] N78-31478
Energy: A continuing bibliography with indexes, issue 17
[NASA-SP-7043[17]] N78-31530
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[NTIS/PS-78/0586/4] N78-31586
Physical properties data compilations relevant to energy storage. 1. Molten salts: Eutectic data --- bibliography
[PB-280795/6] N78-31589
Aircraft air pollution, volume 3. A bibliography with abstracts
[NTIS/PS-78/0623/5] N78-31618
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[NTIS/PS-78/0604/5] N78-31619
Highway traffic noise. A bibliography with abstracts
[NTIS/PS-78/0634/2] N78-31620
Coastal marsh productivity: A bibliography
[PB-281089/3] N78-31688
Bionics. A bibliography with abstracts
[NTIS/PS-78/0550/0] N78-31693
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[NASA-SP-7011[183]] N78-31712
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[NTIS/PS-78/0540/1] N78-31732
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[NTIS/PS-78/0609/4] N78-31773
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Microcomputers. Volume 4, Part 1: General applications. Citations from the engineering index data base
[NTIS/PS-78/0612/8] N78-31775
Microcomputers. Volume 3, part 2: Telecommunication applications. Citations from the engineering index data base
[NTIS/PS-78/0613/6] N78-31776
Microcomputers. Volume 3, part 3: Basic design and development. Citations from the engineering index data base
[NTIS/PS-78/0614/4] N78-31777
Microcomputers. Volume 4, part 3: Basic design and development. Citations from the engineering index data base
[NTIS/PS-78/0615/1] N78-31778
Microcomputers. Part 4: Process control applications. Citations from the engineering index data base
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[NTIS/PS-78/0605/2] N78-31947
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[NTIS/PS-78/0529/4] N78-31959

**BIODYNAMICS**
Dynamics of the recovery of damaged tundra vegetation
[ORO-4180-7] N78-31514

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**BIOINSTRUMENTATION**
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[PB-279834/6] N78-31729

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[JPRS-71595] N78-31705
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N78-31709
Aerospace medicine and biology: A continuing bibliography with indexes, supplement 183
[NASA-SP-7011[183]] N78-31712
Late biological effects of ionizing radiation as influenced by dose, dose rate, age at exposure, and genetic sensitivity to neoplastic transformation
[LA-UR-78-681] N78-31724
Federal noise research in noise effects
[PB-280335/1] N78-31733

**BIOMEDICAL DATA**
Translations on USSR science and technology: Biomedical and Behavioral sciences, no. 39
[JPRS-71569] N78-31697

**BIOMETRICS**
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 35
[JPRS-71467] N78-31694
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 40. Effects on nonionizing electromagnetic radiation
[JPRS-71595] N78-31705

**BIONICS**
Bionics. A bibliography with abstracts
[NTIS/PS-78/0550/0] N78-31693

**BIOSPHERE**
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 40. Effects on nonionizing electromagnetic radiation
[JPRS-71595] N78-31705
Coagulative properties of blood and tissues of the cardiovascular system in exposure to electromagnetic fields
N78-31706
Proliferation of bone marrow cells under the influence of superhigh intensity steady magnetic fields
N78-31707
Possibility of attenuating the ecological effects of alternating current power lines as a result of new designs and circuit changes
N78-31708
Magnet effects in biology
N78-31709

**BIOSYNTHESIS**
The 70 S monosome accumulation and in vitro initiation complex formation by Escherichia coli ribosomes at 5 C
[NASA-CR-157591] N78-31691

**BIOTELEMETRY**
Translations on USSR science and technology: Biomedical and Behavioral sciences, no. 39
[JPRS-71569] N78-31697
A variant of portable single-channel bioradiotelemetry system
N78-31702
A method of recording heat parameters of divers during work
N78-31703

**BIPOLAR TRANSISTORS**
Monolithic 20W 2GHz transistor and monolithic 5W 4GHz transistor
[AD-A055249] N78-31360
A method for the exact determination of noise parameters of active twoports in the frequency range 1 GHz to 11 GHz
[RAE-LIB-TRANS-1963] N78-31877

**BLACK BODY RADIATION**
Blackbody simulator cavity radiation theory
N78-31893

**BLACK HOLES [ASTRONOMY]**
Nuclear gamma rays from compact objects --- nuclear interactions around neutron stars and black holes
N78-31984

**BLADE TIPS**
Advanced optical blade tip clearance measurement system
[NASA-CR-159402] N78-31106
Turbine tip clearance measurement
[AD-A055765] N78-31115

**BLOOD COAGULATION**
Coagulative properties of blood and tissues of the cardiovascular system in exposure to electromagnetic fields
N78-31706

**BLUNT LEADING EDGES**
Diffraction effects of baffles on acoustic directivity patterns
N78-31869

**BOARDS [PAPER]**
The interrelationships of density and fiber orientation on the mechanical properties of fiberboard
N78-31172

**BODY-WING CONFIGURATIONS**
An automated procedure for computing the three-dimensional transonic flow over wing-body combustions, including viscous effects. Volume 2: Program user's manual and code description. Appendix A: Computer code listing and flowchart
[AD-A055109] N78-31050
An automated procedure for computing the three-dimensional transonic flow over wing-body combinations, including viscous effects. Volume 1: Description of analysis methods and applications
[AD-A055899] N78-31052
Development of a computer program to calculate aerodynamic characteristics of bodies and wing-body combinations --- surface pressure distribution in supersonic flow
[AD-A055846] N78-31053

**BOILERS**
Stress-strain behavior of ERNiCr-3 weld filler metal under strain controlled cyclic loading
[ORNL-TM-6128] N78-31228

**BOILING WATER REACTORS**
Detailed analysis of the fundamental ultrasonic response data from stainless steel stress corrosion crack specimens
[EPRI-NP-676-SR] N78-31448

**BOMBS [ORDNANCE]**
Results of a wind tunnel and flight test program to develop a Maximum Volume Bomb [MVB configuration for multiple carriage and separation from tactical-aircraft at mach numbers from 0.50 to 1.10
[AD-A055029] N78-31051

**BONE MARROW**
Proliferation of bone marrow cells under the influence of superhigh intensity steady magnetic fields
N78-31707

**BONES**
Electrical enhancement of healing in combat injuries to hard and soft tissues
[AD-A055531] N78-31718

**BORON COMPOUNDS**
Design of a flow facility for quantitative spectroscopic studies of high temperature species --- infrared absorption coefficients of boron compounds in the vapor phase
[AD-A054842] N78-31187

**BORON FLUORIDES**
Boron trifluoride coatings for thermoplastic materials and method of applying same in glow discharge
[NASA-CASE-ARC-11057-1] N78-31233

**BOUNDARY LAYER CONTROL**
Two-dimensional subsonic wind tunnel evaluation of two related cambered 15-percent thick circulation control airfoils
[AD-A055140] N78-31047
Investigations of a highly loaded compressor cascade with a control of the blade boundary layer. Part 5: Experimental investigations on the cascade with slotted blades
[DLR-IB-151-77/14] N78-31056
Evaluation of a circulation control tail boom for yaw control --- OH-6 helicopter
[AD-A055116] N78-31119

**BOUNDARY LAYER FLOW**
Wall boundary layers in cascades
[ARC-CP-1388] N78-31058
Evaluation of a circulation control tail boom for yaw control --- OH-6 helicopter
[AD-A055116] N78-31119
Verification of a three-dimensional turbulent boundary-layer calculation method
[AD-A055606] N78-31388
Preliminary experiment designed to support a feasibility demonstration of a novel method for developing unsteady boundary layer profiles --- upwash effects of stationary cylinders positioned in wind tunnel
[AD-A055384] N78-31389
Secondary flow vorticity in the passage of a rotor
[AD-A055388] N78-31391

**BOUNDARY LAYER TRANSITION**
Instability, transition to turbulence and predictability
[AGARD-AG-236] N78-31401

**BOUNDARY VALUE PROBLEMS**
A new method for solving surface-piercing-strut problems
[AD-A055078] N78-31270
Singular perturbations of semilinear second order systems
[AD-A055279] N78-31837
Scheme-independent stability criteria for difference approximations of hyperbolic initial-boundary value problems, I
[AD-A055022] N78-31839

**BRAIN**
Neurophysiological assessment of functional states of the brain --- electroencephalographic responses to workloads
N78-31755

**BRAZIL**
INPE LANDSAT system
[E78-10180] N78-31479
Study of geometric distortions of LANDSAT images
[E78-10181] N78-31480
Automatic classification of reforested Pinus SPP and Eucalyptus SPP in Mogi-Guacu, SP, Brazil, using LANDSAT data
[E78-10182] N78-31481
LANDSAT [MSS]: Image demographic estimations
[E78-10183] N78-31482
INPE's crop survey program using combined LANDSAT and aircraft data
[E78-10184] N78-31483
Geological mapping of regional drainage network in Brazil using LANDSAT images
[E78-10185] N78-31484
Use of LANDSAT data to identify and evaluate areas of sugar cane
[E78-10186] N78-31485
Evaluation of orbital images as a basis for land utilization
[E78-10187] N78-31486
Surface hydrodynamical models through synoptic interpretation of LANDSAT MSS images in lagoonal and coastal waters
[E78-10188] N78-31487
Use of LANDSAT imagery for soil survey
[E78-10189] N78-31488
Topographic studies through texture image analysis of LANDSAT data
[E78-10190] N78-31489

Collected summaries of works dealing with the application of LANDSAT imagery in the survey of mineral resources
[E78-10191] N78-31490
Assessment of the damage caused by the frost of 1975 to coffee and wheat crops in the northwest of the state of Parana using LANDSAT images with automatic classification
[E78-10193] N78-31492
Energy analysis of Brazil
N78-31572

BRILLOUIN EFFECT
Brillouin scattering of reflected light by the bulk acoustic phonons in GaAs and CdS
N78-31923

BRITTLENESS
On bounds and approximate solutions for a problem in non-linear creep theory with applications to brittle damage
N78-31454

BUBBLES
Syntactic foam from silver coated microbubbles
[BDX-613-1790-REV] N78-31247

BUFFER STORAGE
Loran-C flight test software
[NASA-CR-157581] N78-31069

BUILDINGS
The tornado: An engineering-oriented perspective -- - wind resistant buildings
[PB-281860/7] N78-31277
Simulation of the urban neutral boundary layer for the model study of wind loads on tall buildings
[PB-280787/3] N78-31278
Solar heating and cooling systems design and development --- prototype development
[NASA-CR-150770] N78-31532
Design data brochure: Solar hot water system
[NASA-CR-150699] N78-31538
Energy analysis of order-disorder phenomenon of man and nature
N78-31565
Some aspects of energy use in housing
N78-31570
Operation Breakthrough site management systems . and pneumatic trash collection, executive summary
[PB-280143/9] N78-31962

BURNERS
Burner design criteria for NOx control from low-BTU gas combustion: Volume 2. Elevated fuel temperature
[PB-280199/1] N78-31615

BURNING RATE
Nitramine propellants --- gun propellant burning rate
[NASA-CASE-NPO-14103-1] N78-31255

BUTT JOINTS
An interactive program for the analysis of fatigue data
N78-31476

## C

CABIN ATMOSPHERES
Simultaneous measurements of ozone outside and inside cabins of two B-747 airliners and a Gates Learjet business jet
[NASA-TM-78983] N78-31061

CADMIUM SULFIDES
Elastophotoconductance in polycrystalline films of cadmium-sulfide
N78-31921
Brillouin scattering of reflected light by the bulk acoustic phonons in GaAs and CdS
N78-31923

CADMIUM TELLURIDES
Anomalous hall effect and oscillatory photoconductivity in p-type mercury cadmium telluride
N78-31926

CALIBRATING
Streak camera time calibration procedures
[NASA-CR-157573] N78-31403
On temperature and yaw dependence of hot-wires
[AD-A055937] N78-31408
Calibration and positional determination of Boller and Chivens 31-inch telescope B
[AD-A055266] N78-32020

CALIFORNIA
Atlas of selected crop spectra, Imperial Valley, California
[E78-10201] N78-31499
Preliminary design manual for a geothermal demonstration plant at Herber, California
[EPRI-ER-670] N78-31575
Experimental investigation of the marine boundary layer in support of air pollution studies in the Los Angeles air basin
[AD-A054239] N78-31592
Analysis of vector wind change with respect to time for Vandenberg Air Force Base, California
[NASA-CR-150776] N78-31663
Analysis of wind bias change with respect to time at Cape Kennedy, Florida, and Vandenberg AFB, California
[NASA-CR-150777] N78-31664

CAMBER
Two-dimensional subsonic wind tunnel evaluation of two related cambered 15-percent thick circulation control airfoils
[AD-A055140] N78-31047

CANADA
Retransmission of hydrometric data in Canada
[E78-10204] N78-31502
Continuation study of the potential for solar heating of buildings in Canada
[NP-23162] N78-31583

CANARD CONFIGURATIONS
Theoretical and experimental methods in the solution of missile nonlinear roll problems
[AD-A055718] N78-31152

CAPACITORS
Marx bank and magnetron circuit model
[UCID-17747] N78-31371

CAPACITY
Analysis of runway occupancy times at major airports
[AD-A056052] N78-31131

CAPE KENNEDY LAUNCH COMPLEX
Analysis of wind bias change with respect to time at Cape Kennedy, Florida, and Vandenberg AFB, California
[NASA-CR-150777] N78-31664
Analysis of vector wind change with respect to time for Cape Kennedy, Florida
[NASA-CR-150779] N78-31665

CAPTURE EFFECT
Capture effect array glide slope guidance study
[AD-A055678] N78-31073

CARBON DIOXIDE
Atmospheric CO2 infrared background investigation. Experimental configuration of 2.7 to 4.3 micrometers fluorescence modeling of 4.3 micrometers spectral structure
[AD-A055943] N78-31643

CARBON DIOXIDE LASERS
Optical rotary saturation --- double resonance interaction
N78-31896

CARBON FIBER REINFORCED PLASTICS
Evaluation of built-in stresses during manufacture of elements made of carbon fiber reinforced plastics
[ESA-CR[P]-1058] N78-31179

CARBON FIBERS
Fabrication of graphite-aluminum composites via pultrusion
[AD-A055257] N78-31173

CARBON MONOXIDE LASERS
Combustion dynamic processes associated with chemical advanced lasing systems
[AD-A055659] N78-31420

CARBON STEELS
Hydrogen attack of steel
[COO-2872-2] N78-31223

CARBON 12
Measurements of 15.11-MeV gamma-ray flux produced in the reactions C-12[p, p']-C-12'[15.11 MeV] and O-16[p, p' alpha]-C-12'[15.11 MeV]
N78-32007

CARDIOVASCULAR SYSTEM
Coagulative properties of blood and tissues of the cardiovascular system in exposure to electromagnetic fields
N78-31706

CARGO AIRCRAFT
Cargo aircraft and spacecraft forward restraint criteria
[AD-A055343] N78-31095

CARGO SPACECRAFT
Cargo aircraft and spacecraft forward restraint criteria
[AD-A055343] N78-31095

CASCADE FLOW
Investigations of a highly loaded compressor cascade with a control of the blade boundary layer. Part 5: Experimental investigations on the cascade with slotted blades
[DLR-IB-151-77/14] N78-31056
Wall boundary layers in cascades
[ARC-CP-1388] N78-31058

CASES [CONTAINERS]
Dynamic analysis of shipping container suspension system for the canister launched version of the HARPOON missile RGM-84A-3A
[AD-A055719] N78-31433

CATALOGS
State-of-the-art for assessing earthquake hazards in the United States. Report 9: Catalogues of strong motion earthquake records. Volume 1: Western United States, 1933-1971
[AD-A055971] N78-31645

CATALYTIC ACTIVITY
Effect of inlet temperature on the performance of a catalytic reactor --- air pollution control
[NASA-TM-78977] N78-31534

CAVITATION FLOW
Initial investigation of stationary hydrofoil cavitation and cavitation noise scaling
[AD-A055260] N78-31271

CAVITIES
Pressure distribution in an open cavity at linear increasing external pressure --- ventilation, vacuum chambers, space simulation chambers
[DLR-FB-77-53] N78-31400
A research program to reduce interior noise in general aviation airplanes: Noise reduction through a cavity-backed flexible plate
[NASA-CR-157588] N78-31873
Blackbody simulator cavity radiation theory
N78-31893

CAVITY RESONATORS
Injection locked, unstable resonator KrF discharge laser with linewidth of 3 GHz
[UCRL-80495] N78-31421

CELESTIAL MECHANICS
Comet Tempel 2: Orbit, ephemerides and error analysis
[NASA-CR-157598] N78-32018

CELLS [BIOLOGY]
Proliferation of bone marrow cells under the influence of superhigh intensity steady magnetic fields
N78-31707
Analytical study of electrophoretic characterization of kidney cells --- conducted during the Apollo Soyuz Test Project
[NASA-CR-150790] N78-31713

CEMENTS
Architectural construction materials. Part 2, volume 2: Concretes and cements. A bibliography with abstracts
[NTIS/PS-78/0527/8] N78-31274

CENSORED DATA [MATHEMATICS]
Testing to determine the underlying distribution using randomly censored data
[AD-A054978] N78-31855

CENTRAL PROCESSING UNITS
Multidomain algorithm evaluation, volume 1
[AD-A054357] N78-31826
Multidomain algorithm evaluation, volume 2
[AD-A054358] N78-31827

CENTRIFUGES
Noise generation and noise propagation in centrifugal fans
[DLR-IB-257-78/1] N78-31879

CERAMICS
Spectral and total emissivity and reflectivity at high temperatures
[AD-A055027] N78-31191
Advanced ceramic material for high temperature turbine tip seals
[NASA-CR-135319] N78-31238
Preliminary evaluation of tubular ceramic heat exchanger materials
[TID-28279] N78-31393
Research on aluminum nitride materials
[AD-A054980] N78-31930
Quantizing the polarization of lead zirconate-titanate
[LBL-7322] N78-31937

CH-47 HELICOPTER
Modified helicopter icing spray system evaluation
[AD-A055039] N78-31091

CHANNEL FLOW
Discharge measurement structures
[PUBL-161] N78-31395
Investigation on the influence of a hydrodynamic precursor stage on the heat transfer at a flat channel wall
[ILR-22] N78-31397
Problems associated with maintenance of channel capacity below federal reservoirs in Kansas
[PB-280560/4] N78-31522

CHARGE COUPLED DEVICES
Impact of charge coupled devices and Surface Acoustic Wave Devices on Signal Processing and Imagery in Advanced Systems --- Conferences
[AGARD-CP-230] N78-31279
State-of-the-art of CCD and SAW technologies
N78-31280
The roles for CCD and SAW in signal processing
N78-31281
Performance limitations of two phase CCD's
N78-31288
The design and development of CCD programmable transversal filters and correlators
N78-31289
A hybrid SAW/CCD signal processor
N78-31290
A wide bandwidth CCD buffer memory system
N78-31291
LSI video compression and computational modules utilizing digital charge coupled devices
N78-31298
Charge coupled devices with simplified drive requirements
N78-31299
IRCCD imaging sensors: A review of device options
N78-31302
CCPD: The optimum solid-state line scanner
N78-31303
Applications of a charge coupled device sensor for Nap-of-the-Earth helicopter operations
N78-31305

A CCD digital image store
N78-31306
A CCD memory chip for radar image processing
N78-31307
Electro-optical processing of signals and images
N78-31308
Charge Injection Device [CID] Hadamard plane processor for image bandwidth compression
N78-31309
A high performance CCD Linear Imaging Array
N78-31310
Development and application of a SAW Chirp-Z transformer
N78-31311
The Chirp Z transform with CCD and SAW technology
N78-31312
Spectral analysis using the CCD Chirp Z-transform
N78-31313
Operation of SAW reflective array pulse compressors in a high performance radar with minus 0.4 meter range resolution
N78-31315
A novel signal integrator using CCDs
N78-31316
CCD delay lines for the processing of a radar signal: Application to an MTI
N78-31317
A CCD delay line Doppler analyser
N78-31318
Combined acquisition and fine synchronization system for spread spectrum receivers using a tapped delay line correlator
N78-31319

**CHARGE DISTRIBUTION**
Microscopic theory of charge density wave instability in NbSe2
[CONF-7709106-1] N78-31197
The influence of overall fuel-air ratio and degree of stratification on the fuel consumption and emissions of a prechamber, stratified-charge engine
N78-31425

**CHARGE TRANSFER**
Performance limitations of two phase CCD's
N78-31288
Measurement techniques and applications of charge transfer to aerospace research
[NASA-TM-78734] N78-31404
Reaction-R constants and simple rate theories applied to the mercury-chloride laser
[AD-A055229] N78-31419

**CHARGE TRANSFER DEVICES**
Modelization of metal insulating semiconductor devices on CgHgTe application to a charge transfer device for infrared imagery
N78-31301

**CHEMICAL ANALYSIS**
Dedicated computer control of chemical instrumentation
[AD-A055268] N78-31190
Material evaluation of polyurethane foam, 0.05 g/cm3 density
[BDX-613-1836-REV] N78-31249
Identification of components of energy-related wastes and effluents
[PB-280203/1] N78-31606
Organic characterization of aerosols and vapor phase compounds in urban atmospheres
[PB-280050/6] N78-31611

**CHEMICAL ATTACK**
Hydrogen attack of steel
[COO-2872-2] N78-31223

**CHEMICAL COMPOSITION**
Nitramine propellants --- gun propellant burning rate
[NASA-CASE-NPO-14103-1] N78-31255

**CHEMICAL EQUILIBRIUM**
A user's guide for REDEQL.EPA. A computer program for chemical equilibria in aqueous systems
[PB-280149/6] N78-31205

**CHEMICAL LASERS**
Reaction-R constants and simple rate theories applied to the mercury-chloride laser
[AD-A055229] N78-31419
Combustion dynamic processes associated with chemical advanced lasing systems
[AD-A055659] N78-31420
Molecular orbital calculations on molecules of Air Force interest --- TNT decomposition and pyrolytic products in rocket exhausts
[AD-A055072] N78-31881

**CHEMICAL PROPERTIES**
Synergistic mechanisms of solid lubricants
[AD-A054741] N78-31243
Investigation of methylpentene polymer [CPX] molding resin
[BDX-613-1905-REV] N78-31248
A literature review: Problem definition studies on selected toxic chemicals. Volume 6: Occupational health and safety and environmental aspects of urea-formaldehyde resins
[AD-A054991] N78-31716

**CHEMICAL REACTIONS**
Synthesis of perfluoroalkylene aromatic diamines
[NASA-CR-159403] N78-31235

**CHESAPEAKE BAY [US]**
Proceedings of the Bi-state Conference on the Chesapeake Bay --- emphasis on water pollution control
[PB-282155/1] N78-31626
Results of benthic studies at Calvert cliffs
[PB-280279/1] N78-31685

**CHIPS [MEMORY DEVICES]**
A CCD memory chip for radar image processing
N78-31307
A novel signal integrator using CCDs
N78-31316

**CHIRP**
Development and application of a SAW Chirp-Z transformer
N78-31311
The Chirp Z transform with CCD and SAW technology
N78-31312
Spectral analysis using the CCD Chirp Z-transform
N78-31313

**CHROMIUM ALLOYS**
Microstructure and magnetic properties of Fe-Cr-Co-V alloys
[LBL-6931] N78-31225

**CHRONOMETERS**
Real time digital sampler
[LA-TR-78-23] N78-31410

**CIRCUIT RELIABILITY**
Integrated circuit reliability, volume 3. A bibliography with abstracts
[NTIS/PS-78/0579/9] N78-31377

**CIRCUITS**
Marx bank and magnetron circuit model
[UCID-17747] N78-31371

**CITIES**
LANDSAT [MSS]: Image demographic estimations
[E78-10183] N78-31482
A statistical sampling of cities: Current and projected involvement in fire prevention and control master planning
[PB-279922/9] N78-31963

**CIVIL AVIATION**
Baseline National Airspace Data Interchange Network [NADIN] data base
[AD-A056112] N78-31949

**CLAYS**
Collected summaries of works dealing with the application of LANDSAT imagery in the survey of mineral resources
[E78-10191] N78-31490

**CLEARANCES**
Advanced optical blade tip clearance measurement system
[NASA-CR-159402] N78-31106

**CLIMATE**
National climate program
[GPO-92-323] N78-31670
Climate simulation
[AD-A055857] N78-31672
The role of technological and lay-out factors, as well as climate, in formation of the air basin in the region of chemical plants
N78-31700

**CLIMATOLOGY**
Use of LANDSAT imagery for soil survey
[E78-10189] N78-31488
Remeasurement of permanent vegetation plots in the Great Smoky Mountains National Park, Tennessee, USA, and the implications of climatic change on vegetation
[ORNL-TM-6083] N78-31515

**CLOSURES**
Spacesuit torso closure
[NASA-CASE-ARC-11100-1] N78-31736

**CLOUD DISPERSAL**
Ion cloud modeling
[AD-A055969] N78-31648

**CMOS**
Radiation effects on MOS/SOS semiconductor devices --- defects in aluminum oxide crystals
[AD-A055925] N78-31934

**COAL**
Thermal and kinetic analysis of the pyrolysis of coals
[EPRI-AF-528] N78-31552

**COAL GASIFICATION**
Study of heat transfer through refractory lined gasifier vessel walls
[FE-2210-18] N78-31385
Assessment of low- and intermediate-Btu gasification of coal
[FE-1216-4] N78-31554

**COAL UTILIZATION**
Coal desulfurization process
[NASA-CASE-NPO-13937-1] N78-31527
Cleaning coal with coal: Coal humic acids for removal of acids, alkali, salinity, and heavy metal pollutants associated with the use of coal as a fuel
[PB-280580/2] N78-31608

**COASTAL ECOLOGY**
Massachusetts coastal zone management program and final environmental impact statement
N78-31681

**COASTAL WATER**
High-frequency techniques and over-the-horizon radar in coastal research
[AD-A054846] N78-31332
Surface hydrodynamical models through synoptic interpretation of LANDSAT MSS images in lagoonal and coastal waters
[E78-10188] N78-31487

**COATING**
Boron trifluoride coatings for thermoplastic materials and method of applying same in glow discharge
[NASA-CASE-ARC-11057-1] N78-31233

**COBALT ALLOYS**
Microstructure and magnetic properties of Fe-Cr-Co-V alloys
[LBL-6931] N78-31225
Investigation of phase equilibria of TaC fiber reinforced cobalt alloys having a directionally solidified eutectic structure aimed at matrix hardening --- turbine blades
[DLR-FB-77-58] N78-31939

**COBALT COMPOUNDS**
Cobalt as an analogue for iron in high temperature experiments on basaltic compositions
N78-31629

**CODERS**
HOL code generator development methodology
[AD-A055383] N78-31804

**CODING**
A machine independent algorithm for code generation and its use in retargetable compilers
N78-31789

**COFFEE**
Assessment of the damage caused by the frost of 1975 to coffee and wheat crops in the northwest of the state of Parana using LANDSAT images with automatic classification
[E78-10193] N78-31492

**COHERENT ELECTROMAGNETIC RADIATION**
Optical rotary saturation --- double resonance interaction
N78-31896

**COHERENT RADIATION**
The design and demonstration of an advanced data collection/position locating system, addendum --- coherent demodulator
[NASA-CR-156813] N78-31819

**COLD ACCLIMATIZATION**
Cold weather stress on humans. A bibliography with abstracts
[NTIS/PS-78/0540/1] N78-31732

**COLD WEATHER**
Cold weather stress on humans. A bibliography with abstracts
[NTIS/PS-78/0540/1] N78-31732

**COLD WORKING**
Alternating tension-compression fatigue strength and property changes of steel after cold deformation at different deformation rates
[RAE-LIB-TRANS-1967] N78-31207

**COLLISION AVOIDANCE**
IPC design validation and flight testing
[AD-A055529] N78-31074
Some important results obtained in the analysis of near midair and midair collisions
[DLR-FB-77-25] N78-31081
Experimental test plan for the evaluation of aircraft separation assurance displays using airline flight simulators
[AD-A055849] N78-31134

**COLORADO**
Nationwide forestry applications program: Procedure 1 applicability to rangeland classification --- Weld County, Colorado
[E78-10202] N78-31500

**COMBAT**
Computerized aircraft attrition program
[AD-A055784] N78-31094

**COMBINATORIAL ANALYSIS**
Combinatorial optimization: What is the state of the art
[AD-A055722] N78-31842

**COMBUSTION CHAMBERS**
Flame stabilization in a ramjet combustion chamber by means of a pilot gas generator
[DLR-FB-77-54] N78-31117
Correlation of combustor acoustic power levels inferred from internal fluctuating pressure measurements
[NASA-TM-78986] N78-31871

**COMBUSTION EFFICIENCY**
Effect of inlet temperature on the performance of a catalytic reactor --- air pollution control
[NASA-TM-78977] N78-31534

**COMBUSTION PHYSICS**
Combustion dynamic processes associated with chemical advanced lasing systems
[AD-A055659] N78-31420

**COMBUSTION PRODUCTS**
Coal desulfurization process
[NASA-CASE-NPO-13937-1] N78-31527
Mechanisms of exhaust pollutants and plume formation in continuous combustion
[AD-A054844] N78-31594

Identification of components of energy-related wastes and effluents
[PB-280203/1] N78-31606
Cleaning coal with coal: Coal humic acids for removal of acids, alkali, salinity, and heavy metal pollutants associated with the use of coal as a fuel
[PB-280580/2] N78-31608
Pollutant measurements in plumes from power plants and cities: A project MISTT report, summer 1975, February 1976, and February 1977
[PB-280198/3] N78-31609
Burner design criteria for NOx control from low-BTU gas combustion: Volume 2. Elevated fuel temperature
[PB-280199/1] N78-31615

COMETS
Comet Tempel 2: Orbit, ephemerides and error analysis
[NASA-CR-157598] N78-32018

COMMAND AND CONTROL
Application of a maximum likelihood parameter estimator to an advanced missile guidance and control system
[AD-A055188] N78-31149
Structured analysis and design of a satellite simulator
[AD-A055192] N78-31150
LANDSAT-1 and LANDSAT-2 flight evaluation report
[E78-10205] N78-31503

COMMAND GUIDANCE
Application of a maximum likelihood parameter estimator to an advanced missile guidance and control system
[AD-A055188] N78-31149

COMMERCIAL AIRCRAFT
Rotor burst protection program: Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1975
[NASA-CR-135304] N78-31105

COMMINUTION
Effect of attrition milling on the reaction sintering of silicon nitride
[NASA-TM-78965] N78-31236

COMMUNICATION
Systems applications of SAW filters and delay lines N78-31294
Background storage management in operating systems for communication computers
[DLR-FB-77-37] N78-31821
Link invariant line programs in communication systems
[DLR-FB-77-38] N78-31822

COMMUNICATION EQUIPMENT
A variant of portable single-channel bioradiotelemetry system N78-31702

COMMUNICATION SATELLITES
Description of the MILSATCOM loading program OPAL
[AD-A054878] N78-31144
User's guide for the MILSATCOM loading program OPAL
[AD-A054879] N78-31145
Description of the MILSATCOM loading program OPAL, GPSCS addendum
[AD-A054880] N78-31146
User's guide for the MILSATCOM loading program OPAL, GPSCS addendum
[AD-A054881] N78-31147
UHF scintillation characteristics as observed from Keflavik, Iceland
[AD-A055760] N78-31344

COMMUNICATIONS TECHNOLOGY SATELLITE
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 1
[NASA-CR-135416-VOL-1] N78-31141
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 2 --- bibliography
[NASA-CR-135416-VOL-2] N78-31142

COMPARTMENTS
Organic emissions from automobile interiors --- indoor air pollution
[PB-280374/0] N78-31605

COMPENSATORY TRACKING
Adaptive compensation techniques
[AD-A055177] N78-31828

COMPILERS
Decompilation N78-31759
Design and implementation of an adaptable compiler for minicomputer type architecture N78-31761
A machine independent algorithm for code generation and its use in retargetable compilers N78-31789
HOL code generator development methodology
[AD-A055383] N78-31804

COMPOSITE MATERIALS
The interrelationships of density and fiber orientation on the mechanical properties of fiberboard N78-31172
TF30 third-stage composite fan blade service program
[AD-A055891] N78-31174
Effects of environment, and damping and coupling properties of composite laminates on panel flutter --- airframe materials
[AD-A055753] N78-31175
Development and evaluation of elastomeric materials for geothermal applications
[JPL-PUB-78-69] N78-31237

COMPRESSIBILITY
The compression of wet snow
[AD-A055246] N78-31639

COMPRESSOR BLADES
Investigations of a highly loaded compressor cascade with a control of the blade boundary layer. Part 5: Experimental investigations on the cascade with slotted blades
[DLR-IB-151-77/14] N78-31056

COMPTON EFFECT
Low energy gamma ray observations with the MPI-Compton telescope --- balloon-borne detectors N78-31980
Search for broad gamma ray lines with the UCR double Compton scatter telescope N78-31981
Gamma ray polarimetry --- compton scattering and pair production
[CONTRIB-156] N78-32004

COMPUTATION
Topics in computational geometry N78-31783

COMPUTER COMPONENTS
The discourse and reference components of PAL
[AD-A055046] N78-31801

COMPUTER DESIGN
Theoretical and experimental investigation of computation errors in two different strapdown inertial navigation [IN]-systems
[FOA-C-20217-E4] N78-31080
Feasibility study for incorporating a data structure definition and manipulation facility within the comrade data management system
[AD-A055097] N78-31765
Microcomputers. Volume 3, part 3: Basic design and development. Citations from the engineering index data base
[NTIS/PS-78/0614/4] N78-31777
Microcomputers. Volume 4, part 3: Basic design and development. Citations from the engineering index data base
[NTIS/PS-78/0615/1] N78-31778
Analysis and performance of computer instruction sets N78-31780

COMPUTER GRAPHICS
WNDROS: A program for displaying wind rose data
[ORNL-CSD-TM-40] N78-31674
Computer science and technology: FORTRAN 4 enhanced character graphics
[PB-279939/3] N78-31772

COMPUTER INFORMATION SECURITY
Control of access to shared information N78-31948

COMPUTER NETWORKS
HISS: An approach to hierarchical system sharing for laboratory computers
[AD-A055152] N78-31769
A distributed mini-computer network
[AD-A055254] N78-31820
Link invariant line programs in communication systems
[DLR-FB-77-38] N78-31822
Computer science and technology: Local area networking. Report of a workshop
[PB-279921/1] N78-31823
Validation of closed queueing network models for the DECsystem-10
[AD-A055118] N78-31830

COMPUTER PROGRAMMING
User's guide for the MILSATCOM loading program OPAL, GPSCS addendum
[AD-A054881] N78-31147
An interactive program for the analysis of fatigue data N78-31476
Decompilation N78-31759
Programming by abstracts demonstration N78-31788
A machine independent algorithm for code generation and its use in retargetable compilers N78-31789
SPAR data handling utilities
[NASA-TM-78701] N78-31793
Computer science and statistics: Annual symposium on the interface
[PB-280370/8] N78-31812
Control of access to shared information N78-31948
Astrometry satellite. Theoretical study of the accuracy. Volume 2: Numerical experiments
[ESA-CR[P]-1068-VOL-2] N78-32025

COMPUTER PROGRAMS
An automated procedure for computing the three-dimensional transonic flow over wing-body combustions, including viscous effects. Volume 2: Program user's manual and code description. Appendix A: Computer code listing and flowchart
[AD-A055109] N78-31050
Development of a computer program to calculate aerodynamic characteristics of bodies and wing-body combinations --- surface pressure distribution in supersonic flow
[AD-A055846] N78-31053
Computing LORAN time differences with an HP-25 hand calculator
[NASA-CR-157580] N78-31067
General aviation airplane structural crashworthiness user's manual. Volume 1: Program KRASH theory
[AD-A055898] N78-31088
Computerized aircraft attrition program
[AD-A055784] N78-31094
A study of analog programming for prediction of crack growth in aircraft structures subjected to random loads
[AD-A055789] N78-31097
Description of the MILSATCOM loading program OPAL
[AD-A054878] N78-31144
User's guide for the MILSATCOM loading program OPAL
[AD-A054879] N78-31145
Description of the MILSATCOM loading program OPAL, GPSCS addendum
[AD-A054880] N78-31146
User's guide for the MILSATCOM loading program OPAL, GPSCS addendum
[AD-A054881] N78-31147
Investigation of real-time satellite-to-satellite tracking using extended Kalman filters
[AD-A055115] N78-31148
A generalized Monte Carlo analysis program for Kalman filter design with application to an aircraft-to-satellite tracking filter
[AD-A055189] N78-31156
Dedicated computer control of chemical instrumentation
[AD-A055268] N78-31190
Propagation model [0.1 to 20 GHz] extensions for 1977 computer programs
[AD-A055605] N78-31324
Method of moment thin wire computer program comparisons for complex structures and coarse accuracy
[AD-A055759] N78-31341
Transient response of filters
[AD-A055324] N78-31366
Study of heat transfer through refractory lined gasifier vessel walls
[FE-2210-18] N78-31385
A simple finite-difference technique for the computation of threedimensional incompressible laminar boundary layers. Part 2: Description of the program
[NLR-TR-76086-U-PT-2] N78-31398
Model verification of large structural systems --- space shuttle model response
[NASA-CR-150811] N78-31464
The coverage field of earth observation satellites at the earth surface. Description of the computer program COFI
[DLR-IB-552-77/40] N78-31516
Continuation study of the potential for solar heating of buildings in Canada
[NP-23162] N78-31583
A computer version of the US Standard Atmosphere, 1978
[NASA-CR-150778] N78-31632
Two FORTRAN programs for calculating global ionospheric amplitude and phase scintillation
[AD-A055273] N78-31641
Physically-based high resolution surface wind and temperature analysis for EPAMS
[AD-A055861] N78-31673
WNDROS: A program for displaying wind rose data
[ORNL-CSD-TM-40] N78-31674
Description and analysis of the Hewlett-Packard 78220 arrhythmia monitoring system
[AD-A055451] N78-31720
Computer program specification for security kernel for PDP-11/45, volume 1
[AD-A054247] N78-31764
Various aspects for correcting and detecting syntactical errors in computer programs
[INPE-1063-NTE/098] N78-31791
An improved computational procedure for determining helicopter rotor blade natural modes
[NASA-TM-78670] N78-31792
Modeling of a latent fault detector in a digital system
[NASA-CR-145371] N78-31794
Computer software for analysis of infrared targets and clutter
[AD-A054235] N78-31796
Preliminary design for multimode matrix perception experiment software
[AD-A055178] N78-31797
Truth maintenance systems for problem solving
[AD-A054826] N78-31799

INTERPOL: An interactive plotting package for off-line Cal Comp systems
[AD-A054762] N78-31800
Software acquisition management guidebook: Cost estimation and measurement
[AD-A055574] N78-31809
Multidomain algorithm evaluation, volume 1
[AD-A054357] N78-31826
Multidomain algorithm evaluation, volume 2
[AD-A054358] N78-31827
A computer program for fitting censored samples to a Weibull distribution [CENWEIR]
[AD-A054833] N78-31856
Least-squares resolution of gamma-ray spectra in environmental samples --- computer program for analyzing sodium iodide gamma spectra
[PB-280237/9] N78-31886

COMPUTER STORAGE DEVICES
A CCD digital image store
N78-31306
Design of a microprocessor based system for testing of the NCR 2051 MNOS memory
[AD-A055200] N78-31767
Background storage management in operating systems for communication computers
[DLR-FB-77-37] N78-31821

COMPUTER SYSTEMS DESIGN
A new loop structure for distributed microcomputing systems
N78-31760
Stochastic modelling of computer systems and networks
N78-31816
Memory management policies for a hardware implemented computer operating system
N78-31817
Control of access to shared information
N78-31948

COMPUTER SYSTEMS PROGRAMS
Loran-C flight test software
[NASA-CR-157581] N78-31069
Software design for a Visually-Coupled Airborne Systems Simulator [VCASS]
[AD-A055226] N78-31133
Specification of reliable large-scale software systems
N78-31786

COMPUTER TECHNIQUES
Computer processing of LANDSAT digital data and sensor interface development for use in New England reservoir management
[AD-A055762] N78-31513
ORIS: The Oak Ridge Imaging System program listings
[ORNL-TM-5875-V3] N78-31722
Computer identification of infrared spectra by correlation-based file searching
[AD-A055277] N78-31770
Computation expressions and their applications in an adaptive computer system
N78-31814
Development of a set of general rigid and flexible body equations of motion in coupled form using the direct approach
N78-31867
A method for the exact determination of noise parameters of active twoports in the frequency range 1 GHz to 11 GHz
[RAE-LIB-TRANS-1963] N78-31877
Copyrights. A bibliography with abstracts
[NTIS/PS-78/0529/4] N78-31959

COMPUTERIZED DESIGN
AFAL simulation facility/capability manual. Volume 1: Executive summary and Systems Avionics Division
[AD-A055591] N78-31102
Automotive diesel technology program --- computerized design
[SAN-1099-1] N78-31436
Programming by abstracts demonstration
N78-31788

COMPUTERIZED SIMULATION
Hybrid trajectory simulation of a parachute system --- low impact velocity two parachute system aerodynamics
[SAND-78-8668] N78-31054
GPSS computer simulation of aircraft passenger emergency evacuations
[AD-A056098] N78-31062
Graphics for the hybrid stores separation simulation of the B77 system
[SAND-78-8212] N78-31099
AFAL simulation facility/capability manual. Volume 1: Executive summary and Systems Avionics Division
[AD-A055591] N78-31102
Structured analysis and design of a satellite simulator
[AD-A055192] N78-31150
Single and dual air curtain jets used as protection against precipitation
[UTIAS-227] N78-31269
Analysis of receiver mixers
[AD-A055283] N78-31362
Large eddy simulation of incompressible turbulent channel flow
[NASA-CR-157575] N78-31383
Atmospheric CO2 infrared background investigation. Experimental configuration of 2.7 to 4.3 micrometers fluorescence modeling of 4.3 micrometers spectral structure
[AD-A055943] N78-31643
Monthly mean simulation experiments with a course-mesh global atmospheric model
[NASA-CR-157574] N78-31662
Mathematical analysis and computer simulation in military mission workload assessment
N78-31758
Simulation of the direct execution of a higher order language
[AD-A055235] N78-31798
Regenerative simulation of response times in networks of Queues II multiple job types
[AD-A055584] N78-31831
Simulation study of the power of the Kolmogoroff-Smirnoff and Z tests for the exponential distribution
[NASA-TP-1311] N78-31854
Simulation of the acquisition management information system
[AD-A055209] N78-31945

COMPUTERS
Array scanning techniques
[AD-A055176] N78-31359

CONCENTRATION [COMPOSITION]
Effects of compositional changes on the performance of a thermal barrier coating system --- yttria-stabilized zirconia coatings on gas turbine engine blades
[NASA-TM-78976] N78-31212
Air quality data: 1977 first quarter statistics
[PB-280184/3] N78-31600
Air quality data: 1977 second quarter statistics
[PB-280185/0] N78-31601
Air quality data: 1976 fourth quarter statistics
[PB-280186/8] N78-31602

CONCRETES
Architectural construction materials. Part 2, volume 2: Concretes and cements. A bibliography with abstracts
[NTIS/PS-78/0527/8] N78-31274

CONDUCTION BANDS
Electrical traps in microwave materials
[AD-A055086] N78-31928

CONDUCTION ELECTRONS
Statistical properties of particles confined by irregular surfaces
N78-31918
Electron scattering rate anisotropy and conduction electron-4f moment interactions Au[rare earth] dilute alloys
N78-31920

CONDUCTIVE HEAT TRANSFER
Transient behavior of solid sensible heat thermal energy storage units
N78-31528

CONFERENCES
Proceedings of AFOSR/AFML Corrosion Workshop
[AD-A055281] N78-31218
Impact of charge coupled devices and Surface Acoustic Wave Devices on Signal Processing and Imagery in Advanced Systems --- Conferences
[AGARD-CP-230] N78-31279
Proceedings of the Bi-state Conference on the Chesapeake Bay --- emphasis on water pollution control
[PB-282155/1] N78-31626
Methods to assess work load
[AGARD-CP-216] N78-31745
Computer science and statistics: Annual symposium on the interface
[PB-280370/8] N78-31812
Computer science and technology: Local area networking. Report of a workshop
[PB-279921/1] N78-31823
Research needs relating to on-site Treatment of Domestic Wastes: Summary of Workshop
[PB-280989/5] N78-31966
Gamma ray spectroscopy in astrophysics --- conferences
[NASA-TM-79619] N78-31971
The energetic particle environment of the solar probe mission: As estimated by the participants of the Solar Probe Environment Workshop
[NASA-CR-157595] N78-32032

CONFIDENCE LIMITS
Method for obtaining confidence-limit values for seismic values calculated from Vibroseis data
[USGS-474-255] N78-31651

CONFIGURATION MANAGEMENT
Configuration management requirements --- for ESA spacecraft and associated equipment development
[ESA-SPEC-QRA-03-ISSUE-3] N78-31157

CONGRESSIONAL REPORTS
Future needs and opportunities in the air traffic control system
[GPO-98-931] N78-31076
International space activities
[GPO-30-920] N78-31137
Briefing on Department of Energy --- management of energy programs
[GPO-20-083] N78-31542
Environmental challenges of the President's energy plan: Implications for research and development
[GPO-96-834] N78-31543
National climate program
[GPO-92-323] N78-31670
Department of Housing and Urban Development, and certain independent agencies appropriations for fiscal year 1979, part 2
[GPO-23-600] N78-31956
Astronauts and cosmonauts biographical and statistical data, revised 31 May 1978
[GPO-30-531] N78-32035

CONIFERS
Automatic classification of reforested Pinus SPP and Eucalyptus SPP in Mogi-Guacu, SP, Brazil, using LANDSAT data
[E78-10182] N78-31481

CONSERVATION
Cypress wetlands for water management, recycling and conservation
[PB-282159/3] N78-31970

CONSOLES
Dulles control tower console design study
[AD-A056200] N78-31132

CONSTRAINTS
The development of quasi-Newton methods for unconstrained minimisation --- of nonlinear functions
[RAE-TR-77132] N78-31845

CONSTRUCTION MATERIALS
Survey and analysis of selected topics within the Energy Research and Development Administration's [ERDA] materials research and development programs
[DOE/ET-0006] N78-31170
Mechanical properties test data for structural materials
[ORNL-5380] N78-31473

CONTINUOUS WAVE RADAR
Space-time signal processing of radar returns
[AD-A055758] N78-31342

CONTROL
Backup control for a variable cycle engine --- fighter aircraft
[AD-A055658] N78-31116
Dynamics of a three degree of freedom kinematic chain
[AD-A055612] N78-31840

CONTROL DATA [COMPUTERS]
An alternating direction implicit method for the Control Data STAR-100 vector computer
[NASA-TP-1282] N78-31836

CONTROL EQUIPMENT
Safety analysis LOX-30 liquid oxygen generator
[AD-A054804] N78-31063
Control system design using vector-valued performance criteria with application to the control rate reduction in parameter insensitive control systems
[DLR-FB-77-55] N78-31125

CONTROL SURFACES
Control-surface hinge-moment calculations for a high-aspect-ratio supercritical wing
[NASA-TM-78664] N78-31043
Two-dimensional subsonic wind tunnel evaluation of two related cambered 15-percent thick circulation control airfoils
[AD-A055140] N78-31047

CONTROL THEORY
A comparison of control modes for time delayed remote manipulation
N78-31737
Digital controller design: Analysis of the annular suspension pointing system --- analog controllers with feedback
[NASA-CR-150807] N78-31825
An analysis of observed system sensitivity to plant parameter variations
[AD-A055190] N78-31829
Investigations of self organizing control laws and possibilities of their realization
[DLR-FB-77-57] N78-31833

CONTROL UNITS [COMPUTERS]
Control of access to shared information
N78-31948

CONTROLLERS
Optimization and estimation in nonlinear systems with application to inertial guidance
N78-31139
Xerox controller design
[AD-A055224] N78-31771
Digital controller design: Analysis of the annular suspension pointing system --- analog controllers with feedback
[NASA-CR-150807] N78-31825

CONVECTIVE FLOW
Evaluation of AAFE apparatus to measure residual and transient convection in zero-gravity
[NASA-TM-78191] N78-31382

CONVEXITY
A new class of feasible direction methods
[AD-A055032] N78-31803

**CONVEYORS**
Critical depth tests of bulk TNT flake explosive --- conveyors for handling explosives safely
[AD-A054739] N78-31260
**CONVOLUTION INTEGRALS**
The design and development of CCD programmable transversal filters and correlators
N78-31289
Convolution and correlation memory by means of surface acoustic wave devices
N78-31297
Applications of piezoelectric convoluters to radar signal processing
N78-31314
Exact fermat number transform convolution with comparison to fast Fourier transform techniques
N78-31762
**COOLING SYSTEMS**
Thermal performance measurements on ultimate heat sinks: Cooling ponds
[NUREG/CR-0008] N78-31394
**COPPER**
Fundamental studies of metal fluorination reactions
[COO-2671-7] N78-31202
**COPPER COMPOUNDS**
Unusual magnetic properties in two copper (II) chelates of Schiff bases derived from alpha-amino acids: A dimeric interaction in a structural linear chain
[AD-A055101] N78-31168
**COPYRIGHTS**
Copyrights. A bibliography with abstracts
[NTIS/PS-78/0529/4] N78-31959
**CORRELATORS**
The design and development of CCD programmable transversal filters and correlators
N78-31289
Experiments and analysis of acoustoelectric memory correlators
N78-31296
Convolution and correlation memory by means of surface acoustic wave devices
N78-31297
Applications of piezoelectric convoluters to radar signal processing
N78-31314
Combined acquisition and fine synchronization system for spread spectrum receivers using a tapped delay line correlator
N78-31319
Tracking servobridge detectors, volume 2
[AD-A055084] N78-31357
Tracking servobridge detectors. Volume 3: Operation sheets
[AD-A055085] N78-31358
**CORROSION**
Survey and analysis of selected topics within the Energy Research and Development Administration's [ERDA] materials research and development programs
[DOE/ET-0006] N78-31170
**CORROSION PREVENTION**
Inhibition of hot salt corrosion by metallic additives
[NASA-TM-78966] N78-31208
Proceedings of AFOSR/AFML Corrosion Workshop
[AD-A055281] N78-31218
**CORROSION RESISTANCE**
The role of passive film growth kinetics and properties in stress corrosion and crevice corrosion susceptibility
[AD-A055366] N78-31219
Lithium compatibility research: Status and requirements for ferrous materials
[CONF-780308-6] N78-31224
**COSMIC RAYS**
Observational evidence for extraterrestrial gamma-ray line sources
N78-31983
Gamma ray astronomy and the origin of the light nuclei --- cosmic ray and interstellar gas reactions
N78-31986
**COSMONAUTS**
Astronauts and cosmonauts biographical and statistical data, revised 31 May 1978
[GPO-30-531] N78-32035
**COST ANALYSIS**
Design and cost study for development of lead-acid batteries suitable for electric vehicle propulsion
[ANL-K-77-3624-1] N78-31548
**COST EFFECTIVENESS**
Applications of thermal energy storage to process heat storage and recovery in the paper and pulp industry
[NASA-CR-159398] N78-31537
Energy-quality calculations for freshwater chemical potential
N78-31566
Outline of cost-benefit analysis and a case study
[NASA-TM-78984] N78-31954
**COST ESTIMATES**
Estimated costs of extended low-rate airframe production
[AD-A054834] N78-31100
The relative costs of producing syncrude from oil shales of various grades under varying conditions
[ERG-022] N78-31268
Solar Pilot Plant, phase 1: Preliminary design report. Volume 7: Pilot plant cost, commercial plant cost and performance, CDRL item 2
[SAN-1109-8/9-VOL-7] N78-31574
Software acquisition management guidebook: Cost estimation and measurement
[AD-A055574] N78-31809
Social opportunity cost of capital: Empirical estimates
[ANL-SPG-2] N78-31955
**COTTON**
Atlas of selected crop spectra, Imperial Valley, California
[E78-10201] N78-31499
**COULOMB COLLISIONS**
The excitation of electronic transverse energy levels in an intense magnetic field
N78-31996
**COVARIANCE**
Speech compression and evaluation
[AD-A055019] N78-31338
**CRACK INITIATION**
EPRI-NASA cooperative project on stress corrosion cracking of Zircaloys --- nuclear fuel failures
[NASA-CR-157577] N78-31230
Fundamental study of crack initiation and propagation
[UCRL-80478] N78-31474
**CRACK PROPAGATION**
Cyclic ductility cyclic strength and fatigue crack propagation of metals and alloys
[AD-A055359] N78-31220
Crack tip plasticity in dynamic fracture mechanics
[AD-A055159] N78-31470
Fundamental study of crack initiation and propagation
[UCRL-80478] N78-31474
**CRACKING [FRACTURING]**
A study of analog programming for prediction of crack growth in aircraft structures subjected to random loads
[AD-A055789] N78-31097
Continuing crack tip deformation and fracture for plane-strain crack growth in elastic-plastic solids
[COO-3084-56] N78-31472
**CRASHES**
General aviation airplane structural crashworthiness user's manual. Volume 1: Program KRASH theory
[AD-A055898] N78-31088
**CREEP ANALYSIS**
Three-dimensional inelastic analysis of a small liquid sodium valve
[HEDL-TME-77-91] N78-31435
On bounds and approximate solutions for a problem in non-linear creep theory with applications to brittle damage
N78-31454
**CREEP PROPERTIES**
A nonlinear uniaxial integral constitutive equation incorporative rate effects, creep, and relaxation
[AD-A054252] N78-31216
Elevated temperature creep and fatigue damage of a 2.25 Cr-1 Mo steel weldment
[SAND-77-1556] N78-31229
**CROP IDENTIFICATION**
INPE's crop survey program using combined LANDSAT and aircraft data
[E78-10184] N78-31483
Use of LANDSAT data to identify and evaluate areas of sugar cane
[E78-10186] N78-31485
Atlas of selected crop spectra, Imperial Valley, California
[E78-10201] N78-31499
Linear feature selection with applications
[E78-10206] N78-31504
Analysis of scanner data for crop inventories
[E78-10207] N78-31505
**CROP INVENTORIES**
INPE's crop survey program using combined LANDSAT and aircraft data
[E78-10184] N78-31483
Analysis of scanner data for crop inventories
[E78-10207] N78-31505
**CROSSED FIELD AMPLIFIERS**
Design, fabrication and testing of a CFA for use in the solar power satellite
[NASA-CR-159410] N78-31143
**CROSSED FIELDS**
Repetitive series interrupter 2
[AD-A055253] N78-31363
**CROSSLINKING**
Polymeric foams from cross-linkable poly-n-ary lenebenzimidazoles
[NASA-CASE-ARC-11008-1] N78-31232
**CRUDE OIL**
Preliminary findings and views concerning the exemption of aviation gasoline from the mandatory petroleum allocation and price regulations
[DOE/ERA-0001] N78-31957
Preliminary findings and views concerning the exemption of kerojet fuels from the mandatory petroleum allocation and price regulations
[DOE/ERA-0002] N78-31958
**CRYOGENICS**
Cryogenic recovery analysis of forced flow supercritical helium cooled superconductors
[WFPS-TME-039] N78-31273
Summary of work on cooled ion frequency standard
[AD-A054234] N78-31880
**CRYSTAL DEFECTS**
Radiation effects on MOS/SOS semiconductor devices --- defects in aluminum oxide crystals
[AD-A055925] N78-31934
**CRYSTAL GROWTH**
Research on aluminum nitride materials
[AD-A054980] N78-31930
**CRYSTAL LATTICES**
Structure of gain boundaries in silicon nitride based alloys --- electron microscopy of MgO, Y2O3, and magnesium-sialon
[LBL-6985] N78-31177
**CRYSTAL STRUCTURE**
Form-stable crystalline polymer pellets for thermal energy storage, phase 1
[ORO-5159-10] N78-31582
Elastic properties of one-dimensional conductors and semiconductors
N78-31913
Surface and bulk electronic properties of d-band perovskites
N78-31916
**CURVE FITTING**
Efficiency and investment matching of high quality energy
N78-31560
Reevaluation of Modified Mercalli Intensity Scale for earthquakes using distance as determinant
[PB-281459/8] N78-31657
A computer program for fitting censored samples to a Weibull distribution [CENWEIR]
[AD-A054833] N78-31856
**CURVED PANELS**
A study of the structural-acoustic response and interior noise levels of fuselage structures
[NASA-CR-157589] N78-31872
**CYCLES**
Atmospheric pathways of the phosphorus cycle
N78-31590
**CYCLIC HYDROCARBONS**
Multiheteromacrocycles that complex metal ions
[SAN-34P218X4] N78-31194
**CYCLIC LOADS**
Correlation of low-cycle and high-cycle fatigue data for solution-annealed Incoloy-800
[BNL-NUREG-23776] N78-31222
Stress-strain behavior of ERNiCr-3 weld filler metal under strain controlled cyclic loading
[ORNL-TM-6128] N78-31228
Constant-amplitude and program-load fatigue tests at low cyclic frequencies on thick aluminium alloy pin joints
[ARL-STRUC-REPT-365] N78-31457
**CYCLOTRON RADIATION**
Cyclotron lines form Her X-1
N78-31991
Cyclotron emission in neutron star magnetospheres
N78-31995
The transfer of cyclotron lines through the magnetospheric shell of Hercules X-1
N78-31997
Theory of the accretion column and cyclotron radiation in X ray pulsars
N78-31998
Gamma ray facilities at the University of Maryland cyclotron --- data acquisition and radiation measurement
N78-32008
**CYCLOTRON RESONANCE**
Alfven/ion cyclotron waves and the ion cyclotron instability in the earth's magnetosphere
N78-31628
Quantum theory of cyclotron resonance lineshape for the inversion layer electrons in Metal-Oxide-Semiconductor [MOS]
N78-31925
Upper limits on the cyclotron lines from Her X-1 as observed with OSO-8
N78-31993
**CYGNUS CONSTELLATION**
High energy X-ray spectra of cygnus XR-1 observed from OSO-8
[NASA-TM-79626] N78-32017
**CYLINDRICAL SHELLS**
Design and fabrication of a ring-stiffened graphite-epoxy corrugated cylindrical shell
[NASA-CR-3026] N78-31465
**CYLINDRICAL TANKS**
Transient behavior of solid sensible heat thermal energy storage units
N78-31528

# D


**D REGION**
Reaction rate data, number 61
[AD-A055983] N78-31644

**DAMPING**
Damper winding reactance
[AD-A055199] N78-31364
Transverse compressional damping in the vibratory response of elastic-viscoelastic-elastic beams
[AD-A054769] N78-31468

**DATA ACQUISITION**
IPC design validation and flight testing
[AD-A055529] N78-31074
World Weather Watch. The role of satellites in WMO programmes in the 1980s
[WMO-494] N78-31676
Interactive signal analysis and ultrasonic data collection system user's manual
[NASA-CR-150798] N78-31763
Software acquisition management guidebook: Cost estimation and measurement
[AD-A055574] N78-31809
The design and demonstration of an advanced data collection/position locating system, addendum --- coherent demodulator
[NASA-CR-156813] N78-31819
Gamma ray facilities at the University of Maryland cyclotron --- data acquisition and radiation measurement
N78-32008

**DATA BASES**
Development of a data base for assessing plastic fire hazards
[PB-280027/4] N78-31254
Microcomputers: General applications. Citations from the NTIS data base
[NTIS/PS-78/0609/4] N78-31773
Microcomputers. Part 1: General applications. Citations from the engineering index data base
[NTIS/PS-78/0611/0] N78-31774
Microcomputers. Volume 4, Part 1: General applications. Citations from the engineering index data base
[NTIS/PS-78/0612/8] N78-31775
Microcomputers. Volume 3, part 2: Telecommunication applications. Citations from the engineering index data base
[NTIS/PS-78/0613/6] N78-31776
Microcomputers. Volume 3, part 3: Basic design and development. Citations from the engineering index data base
[NTIS/PS-78/0614/4] N78-31777
Microcomputers. Volume 4, part 3: Basic design and development. Citations from the engineering index data base
[NTIS/PS-78/0615/1] N78-31778
Microcomputers. Part 4: Process control applications. Citations from the engineering index data base
[NTIS/PS-78/0616/9] N78-31779
SPAR data handling utilities
[NASA-TM-78701] N78-31793
Baseline National Airspace Data Interchange Network [NADIN] data base
[AD-A056112] N78-31949

**DATA COLLECTION PLATFORMS**
LANDSAT policy issues still unresolved
[PB-279701/7] N78-31517

**DATA COMPRESSION**
Speech compression and evaluation
[AD-A055019] N78-31338

**DATA CORRELATION**
Cyclic ductility cyclic strength and fatigue crack propagation of metals and alloys
[AD-A055359] N78-31220
Correlation of combustor acoustic power levels inferred from internal fluctuating pressure measurements
[NASA-TM-78986] N78-31871

**DATA MANAGEMENT**
Risk analysis in environmental studies. 1: Risk analysis methodology, a statistical approach. 2: Data management for environmental studies
[RHO-SA-33] N78-31597
Feasibility study for incorporating a data structure definition and manipulation facility within the comrade data management system
[AD-A055097] N78-31765
SPAR data handling utilities
[NASA-TM-78701] N78-31793
Memory management policies for a hardware implemented computer operating system
N78-31817
Current knowledge on numerical data indexing and possible future developments
[PB-279924/5] N78-31953

**DATA PROCESSING**
The skylab S191 spectrometer experiment: Analysis of data and their applications to the earth sciences
[NASA-TM-58208] N78-31509
Computer processing of LANDSAT digital data and sensor interface development for use in New England reservoir management
[AD-A055762] N78-31513
World Weather Watch. The role of satellites in WMO programmes in the 1980s
[WMO-494] N78-31676
Navy Distributed Computer Systems Workshop
[AD-A055080] N78-31766
Stochastic modelling of computer systems and networks
N78-31816
Memory management policies for a hardware implemented computer operating system
N78-31817
Large scale information systems, volume 1
[AD-A054942] N78-31950

**DATA SYSTEMS**
Performance evaluation of wind energy conversion systems using the method of bins: Current status
[SAND-77-1375] N78-31580
SPAR data handling utilities
[NASA-TM-78701] N78-31793

**DATA TRANSMISSION**
INPE LANDSAT system
[E78-10180] N78-31479

**DEATH VALLEY [CA]**
Geologic application of thermal inertia imaging using HCMM data
[E78-10195] N78-31493

**DECIDUOUS TREES**
Automatic classification of reforested Pinus SPP and Eucalyptus SPP in Mogi-Guacu, SP, Brazil, using LANDSAT data
[E78-10182] N78-31481
AGRESTE project: Agricultural resources investigations in northern Italy and southern France
[E78-10199] N78-31497

**DECISION MAKING**
Decision making in management. A bibliography with abstracts
[NTIS/PS-78/0605/2] N78-31947

**DEFENSE COMMUNICATIONS SYSTEM [DCS]**
Teper technical evaluation program evaluation and restructuring
[AD-A055757] N78-31343

**DEFLECTORS**
A laser scanner for 35mm film
[NASA-CR-150810] N78-31412

**DEFORESTATION**
Use of LANDSAT data to monitor pasture project in Amazonia
[E78-10192] N78-31491

**DEFORMATION**
The constant volume hypothesis for the inelastic deformation of metals in the small strain range
[AD-A054253] N78-31215

**DEICERS**
Demonstration of the microwave ice protection concept
[AD-A055824] N78-31096
Optimization and testing of highway materials to mitigate ice adhesion
[PB-280927/5] N78-31276

**DELAY LINES**
Charge coupled devices with simplified drive requirements
N78-31299
CCD delay lines for the processing of a radar signal: Application to an MTI
N78-31317
A CCD delay line Doppler analyser
N78-31318
Combined acquisition and fine synchronization system for spread spectrum receivers using a tapped delay line correlator
N78-31319

**DELTA WINGS**
Aerodynamic characteristics of a hypersonic research airplane concept having a 70 deg swept double-delta wing at Mach number 0.2
[NASA-TP-1252] N78-31045

**DEMAND [ECONOMICS]**
Integrating policy analysis: Study module 7. Volume 2: Technical appendix
[PB-280037/3] N78-31587

**DEMODULATORS**
Tracking servobridge detector, volume 1
[AD-A055083] N78-31356
Tracking servobridge detectors, volume 2
[AD-A055084] N78-31357
Tracking servobridge detectors. Volume 3: Operation sheets
[AD-A055085] N78-31358
The design and demonstration of an advanced data collection/position locating system, addendum --- coherent demodulator
[NASA-CR-156813] N78-31819

**DENSITY [MASS/VOLUME]**
The interrelationships of density and fiber orientation on the mechanical properties of fiberboard
N78-31172
The compression of wet snow
[AD-A055246] N78-31639

**DENSITY DISTRIBUTION**
Conditions for strong consistency of M-estimators for location
N78-31846

**DENSITY MEASUREMENT**
Atmospheric density measurement in the middle atmosphere --- betasonde
[AD-A055773] N78-31646

**DEPTH**
Critical depth tests of bulk TNT flake explosive --- conveyors for handling explosives safely
[AD-A054739] N78-31260

**DESALINIZATION**
Energy-quality calculations for freshwater chemical potential
N78-31566

**DESCENT TRAJECTORIES**
Hybrid trajectory simulation of a parachute system --- low impact velocity two parachute system aerodynamics
[SAND-78-8668] N78-31054

**DESIGN ANALYSIS**
Automated design of structures subject to stress, displacement and temperature constraints
N78-31456
Design and cost study for development of lead-acid batteries suitable for electric vehicle propulsion
[ANL-K-77-3624-1] N78-31548

**DESULFURIZING**
Coal desulfurization process
[NASA-CASE-NPO-13937-1] N78-31527
Flue gas desulfurization systems: Design and operating considerations. Volume 1: Executive summary
[PB-280253/6] N78-31598
Flue gas desulfurization systems: Design and operating considerations. Volume 2: Technical report
[PB-280254/4] N78-31599

**DETECTORS**
A modular adaptive, variable function flight control sensor
[AD-A055175] N78-31120

**DETONATION**
High-temperature shock initiation of explosives
[LA-7158] N78-31267

**DETONATION WAVES**
Determination of minimum non-propagation distance of aluminum buckets containing 15 pounds of composition A5 --- handling high explosives
[AD-A054737] N78-31259

**DEUTERIUM COMPOUNDS**
Vibrational relaxation and energy transfer of matrix isolated HCl and DCl
[LBL-7344] N78-31885

**DIAGNOSIS**
Diagnostic improvements in medical ultrasonic imaging systems
N78-31710

**DIAGRAMS**
Energy diagrams of published energy analysis of others
N78-31561

**DIAMINES**
Synthesis of perfluoroalkylene aromatic diamines
[NASA-CR-159403] N78-31235

**DIATOMIC MOLECULES**
Spectroscopic studies of ultraviolet lasing transitions in diatomic molecules
[ORO-5005-16] N78-31423

**DIELECTRIC PROPERTIES**
Temperature dependence of the dielectric constant of quartz polyimide, part 2
[AD-A055105] N78-31239
A comparison between derived internal dielectric properties and radio-echo sounding records of the ice sheet at Cape Folger, Antarctica
[AD-A055245] N78-31638

**DIESEL ENGINES**
Automotive diesel technology program --- computerized design
[SAN-1099-1] N78-31436
Off design performance of supercharged two stroke diesel engines
N78-31437
Physical and chemical phenomena responsible for odor formation in diesel engines
[PB-280544/8] N78-31621

**DIFFRACTION PATTERNS**
Diffraction effects of baffles on acoustic directivity patterns
N78-31869

**DIFFUSE RADIATION**
Molecular two-dimensional flow of mixtures of light and heavy gases with diffuse and specular reflection --- preliminary experiments for Spacelab
[DLR-FB-77-51] N78-31060

**DIFFUSION**
Fundamental stochastic models of the transport of water and solutes through saturated and unsaturated porous media
[PB-279772/8] N78-31519

**DIFFUSION COEFFICIENT**
Development of vertical dispersion coefficients for deep-valley terrain
[COO-4026-3] N78-31596
Direct observation of grain boundary diffusion by scanning Auger microscopy --- scanning electron microscopy of metal films
[COO-2679-14] N78-31935

**DIFFUSIVITY**
Nonlinear treatment of self-diffusion in liquids --- incoherent scattering law
N78-31185

**DIGITAL COMPUTERS**
General aviation airplane structural crashworthiness user's manual. Volume 1: Program KRASH theory
[AD-A055898] N78-31088
Navy Distributed Computer Systems Workshop
[AD-A055080] N78-31766
Analysis and performance of computer instruction sets
N78-31780

**DIGITAL DATA**
A wide bandwidth CCD buffer memory system
N78-31291
A CCD digital image store
N78-31306
Computer processing of LANDSAT digital data and sensor interface development for use in New England reservoir management
[AD-A055762] N78-31513
Digital enhancement of computerized axial tomograms
[NASA-TM-78974] N78-31690

**DIGITAL FILTERS**
A microprocessor controlled electrically programmable transversal filter
N78-31292
Investigation of optimal linear shift-invariant two-dimensional digital filters
[AD-A055449] N78-31369
Exact fermat number transform convolution with comparison to fast Fourier transform techniques
N78-31762

**DIGITAL SYSTEMS**
Backup control for a variable cycle engine --- fighter aircraft
[AD-A055658] N78-31116
Inherent errors in asynchronous digital flight controls
[AD-A055649] N78-31124
LSI video compression and computational modules utilizing digital charge coupled devices
N78-31298
Modeling of a latent fault detector in a digital system
[NASA-CR-145371] N78-31794
Digital controller design: Analysis of the annular suspension pointing system --- analog controllers with feedback
[NASA-CR-150807] N78-31825

**DILUTION**
Electron scattering rate anisotropy and conduction electron-4f moment interactions Au[rare earth] dilute alloys
N78-31920

**DIODES**
Experiments and analysis of acoustoelectric memory correlators
N78-31296
Analysis of receiver mixers
[AD-A055283] N78-31362
REB focusing in a high-voltage diode --- pulsed electron accelerators
[SAND-78-6005] N78-31883

**DIRECTIONAL ANTENNAS**
Nodding feed antenna for communications with satellites in sychronous orbit
[NASA-TM-78989] N78-31155

**DISCHARGE COEFFICIENT**
Discharge measurement structures
[PUBL-161] N78-31395

**DISEASES**
AGRESTE project: Agricultural resources investigations in northern Italy and southern France
[E78-10199] N78-31497

**DISPERSIONS**
Development of vertical dispersion coefficients for deep-valley terrain
[COO-4026-3] N78-31596

**DISPLACEMENT MEASUREMENT**
Measurements of mixed-mode crack surface displacements and comparison with theory
[NASA-CR-157579] N78-31459

**DISPLAY DEVICES**
Dulles control tower console design study
[AD-A056200] N78-31132
Experimental test plan for the evaluation of aircraft separation assurance displays using airline flight simulators
[AD-A055849] N78-31134
Digital spectrometer scan controller
[COO-913-67] N78-31409
WNDROS: A program for displaying wind rose data
[ORNL-CSD-TM-40] N78-31674
Display size and target acquisition perforance
[AD-A054624] N78-31741
Preliminary design for multimode matrix perception experiment software
[AD-A055178] N78-31797
Representing visual information
[AD-A055045] N78-31951

**DISTANCE MEASURING EQUIPMENT**
A design of trajectory estimator using multiple DME range measurements
[AD-A055191] N78-31077

**DISTORTION**
Study of geometric distortions of LANDSAT images
[E78-10181] N78-31480

**DISTRIBUTION [PROPERTY]**
Distribution of naphthalene between commercial resins and water-methanol solutions
[IS-T-802] N78-31193

**DISTRIBUTION FUNCTIONS**
Smoothing magic in renewal theory
N78-31834
A study of weighted distributions and size-biased sampling
N78-31847
Measures on the integers and limit distributions of additive, number-theoretic functions
N78-31848
Testing to determine the underlying distribution using randomly censored data
[AD-A054978] N78-31855

**DISTRICT OF COLUMBIA**
A demonstration of areawide water resources planning --- district of columbia
[PB-280750/1] N78-31521

**DIVING [UNDERWATER]**
A method of recording heat parameters of divers during work
N78-31703

**DOMAIN WALL**
Domain orientation in single crystal TbFe[2] and Tb[.27]Dy[.73]Fe[2]
[AD-A055025] N78-31931

**DOMESTIC ENERGY**
Double-exposure collector system
[TID-28291] N78-31576
Continuation study of the potential for solar heating of buildings in Canada
[NP-23162] N78-31583

**DOMESTIC SATELLITE COMMUNICATIONS SYSTEMS**
The 20/30 GHz satellite systems technology needs assessment
[NASA-TM-78975] N78-31323

**DOPED CRYSTALS**
Thermodynamic interpretation of secondary ion and photon emission during sputtering of silicon
N78-31912
Studies of indium-doped silicon
[AD-A054479] N78-31927

**DOPPLER RADAR**
A CCD delay line Doppler analyser
N78-31318

**DOSIMETERS**
Use of a metal-nitride-oxide-semiconductor as the detector for a radiation dosimeter
[AD-A055187] N78-31932

**DRAINAGE**
Draining characteristics of hemispherically bottomed cylinders in a low-gravity environment
[NASA-TP-1297] N78-31384
Using topographic characteristics to predict total solute concentrations in streams draining small forested watersheds in Western Montana
[PB-280578/6] N78-31520

**DRAINAGE PATTERNS**
Geological mapping of regional drainage network in Brazil using LANDSAT images
[E78-10185] N78-31484
Use of LANDSAT imagery for soil survey
[E78-10189] N78-31488

**DROPS (LIQUIDS)**
Radiative and gas cooling of falling molten drops
[NASA-TM-78189] N78-31381

**DRUMS (CONTAINERS)**
Determination of minimum non-propagation distance of aluminum buckets containing 15 pounds of composition A5 --- handling high explosives
[AD-A054737] N78-31259

**DUCTILITY**
Ductile superconducting wire through novel metallurgical techniques --- using V3Ga
[LBL-7366] N78-31227

**DYES**
Strong sensitizers
[PB-280475/5] N78-31728

**DYNAMIC CHARACTERISTICS**
Turbine engine rotordynamic evaluation, volume 1
[AD-A055262] N78-31111
Geodynamic international-11
[PB-280747/7] N78-31660
Design and construction of the Donner 280-crystal positron ring for dynamic transverse section emission imaging
[LBL-5679] N78-31721
Capabilities of germanium detectors --- gamma ray spectoscopy
N78-32000

**DYNAMIC LOADS**
Crack tip plasticity in dynamic fracture mechanics
[AD-A055159] N78-31470

**DYNAMIC MODELS**
Flow-induced gate vibrations: Prevention of self-excitation. Computation of dynamic gate behaviour and the use of models
[PUBL-164] N78-31396
Model verification of large structural systems --- space shuttle model response
[NASA-CR-150811] N78-31464
Modelling parallel systems with dynamic structure
N78-31815

**DYNAMIC RESPONSE**
Engine/airframe/drive train dynamic interface documentation
[AD-A055766] N78-31114
Effects of environment, and damping and coupling properties of composite laminates on panel flutter --- airframe materials
[AD-A055753] N78-31175
Impact of rock debris on a simply supported beam
[AD-A055077] N78-31467

**DYNAMIC STRUCTURAL ANALYSIS**
Model verification of large structural systems --- space shuttle model response
[NASA-CR-150811] N78-31464

**DYNAMIC TESTS**
Techniques for dynamic fracture toughness measurements
[PB-280083/7] N78-31656

**DYSPROSIUM COMPOUNDS**
Domain orientation in single crystal TbFe[2] and Tb[.27]Dy[.73]Fe[2]
[AD-A055025] N78-31931

## E

**EARTH ATMOSPHERE**
Monthly mean simulation experiments with a course-mesh global atmospheric model
[NASA-CR-157574] N78-31662

**EARTH AXIS**
Earth orientation from lunar laser range-differencing
[NASA-CR-157592] N78-32027

**EARTH CRUST**
Hot dry rock, an alternate geothermal energy resource: A challenge for instrumentation
[LA-UR-78-707] N78-31553

**EARTH MANTLE**
Study of magma sources, mantle structure and the differentiation of the earth from variations of Nd-143/Nd-144 in igneous rocks
N78-31630

**EARTH MOVEMENTS**
State-of-the-art for assessing earthquake hazards in the United States. Report 9: Catalogues of strong motion earthquake records. Volume 1: Western United States, 1933-1971
[AD-A055971] N78-31645

**EARTH RESOURCES**
The coverage field of earth observation satellites at the earth surface. Description of the computer program COFI
[DLR-IB-552-77/40] N78-31516

**EARTH RESOURCES INFORMATION SYSTEM**
The skylab S191 spectrometer experiment: Analysis of data and their applications to the earth sciences
[NASA-TM-58208] N78-31509

**EARTH RESOURCES PROGRAM**
An evaluation of the first four LANDSAT-D thematic mapper reflective sensors for monitoring vegetation: A comparison with other satellite sensor systems
[NASA-TM-79617] N78-31510
Computer processing of LANDSAT digital data and sensor interface development for use in New England reservoir management
[AD-A055762] N78-31513
LANDSAT policy issues still unresolved
[PB-279701/7] N78-31517

**EARTH RESOURCES SURVEY PROGRAM**
Earth resources: A continuing bibliography with indexes, issue 18
[NASA-SP-7041[18]] N78-31478

**EARTH SURFACE**
Instruments for measuring the amount of moisture in the air
[NASA-TM-78190] N78-31405
The coverage field of earth observation satellites at the earth surface. Description of the computer program COFI
[DLR-IB-552-77/40] N78-31516

**EARTHQUAKES**
Energy analysis of order-disorder phenomenon of man and nature
N78-31565
State-of-the-art for assessing earthquake hazards in the United States. Report 9: Catalogues of strong motion earthquake records. Volume 1: Western United States, 1933-1971
[AD-A055971] N78-31645
Reevaluation of Modified Mercalli Intensity Scale for earthquakes using distance as determinant
[PB-281459/8] N78-31657

**ECOLOGY**
Diversity of stream communities under conditions of pollution stress
[PB-280500/0] N78-31622

Results of benthic studies at Calvert cliffs
[PB-280279/1] N78-31685
Possibility of attenuating the ecological effects of alternating current power lines as a result of new designs and circuit changes
N78-31708

ECONOMETRICS
Integrating policy analysis: Study module 7. Volume 2: Technical appendix
[PB-280037/3] N78-31587

ECONOMIC ANALYSIS
Telecommunication: Economic studies. A bibliography with abstracts
[NTIS/PS-78/0581/5] N78-31352
Outline of cost-benefit analysis and a case study
[NASA-TM-78984] N78-31954
Social opportunity cost of capital: Empirical estimates
[ANL-SPG-2] N78-31955
Department of Housing and Urban Development, and certain independent agencies appropriations for fiscal year 1979, part 2
[GPO-23-600] N78-31956

ECONOMIC DEVELOPMENT
Energy analysis of Brazil
N78-31572

ECONOMIC FACTORS
The outlook for automotive fuel supplies, alternative vehicle engines, and potential implications for transportation tax structures [1985-2000]
[PB-279679/5] N78-31440
Energy models of exchange with simulation of the role of exchange in spatial organization
N78-31559
A meso-model of the economy of the United States for comparison of economic and energetic analysis
N78-31562

ECONOMICS
Hydrogen technology, foreign
[AD-A055024] N78-31261

ECOSYSTEMS
Nationwide forestry applications program: Ten-Ecosystem Study [TES] site 5 report, Kershaw County, South Carolina, report 4
[E78-10203] N78-31501

EDDY VISCOSITY
Large eddy simulation of incompressible turbulent channel flow
[NASA-CR-157575] N78-31383

EFFECTIVE PERCEIVED NOISE LEVELS
The influence of background noise level and signal duration on the judged annoyance of aircraft noise
[UTIAS-228] N78-31875

EFFLUENTS
Identification of components of energy-related wastes and effluents
[PB-280203/1] N78-31606

EINSTEIN EQUATIONS
Integral formulation of Einstein's equations and Mach's principle
N78-31866

ELASTIC DAMPING
Effects of environment, and damping and coupling properties of composite laminates on panel flutter --- airframe materials
[AD-A055753] N78-31175

ELASTIC DEFORMATION
Elastophotoconductance in polycrystalline films of cadmium-sulfide
N78-31921

ELASTIC PROPERTIES
Elastic properties of one-dimensional conductors and semiconductors
N78-31913

ELASTOMERS
Development and evaluation of elastomeric materials for geothermal applications
[JPL-PUB-78-69] N78-31237

ELASTOPLASTICITY
The influence of the environment on the elastoplastic properties of adhesives in metal bonded joints --- in aircraft structures
[DLR-FB-77-63] N78-31251
Continuing crack tip deformation and fracture for plane-strain crack growth in elastic-plastic solids
[COO-3084-56] N78-31472

ELECTRIC AUTOMOBILES
Design and cost study of a nickel-iron oxide battery for electric vehicles. Volume 2: Public report
[ANL-K-3723-1] N78-31551

ELECTRIC BRIDGES
Tracking servobridge detector, volume 1
[AD-A055083] N78-31356
Tracking servobridge detectors, volume 2
[AD-A055084] N78-31357
Tracking servobridge detectors. Volume 3: Operation sheets
[AD-A055085] N78-31358

ELECTRIC COILS
Damper winding reactance
[AD-A055199] N78-31364

ELECTRIC CONDUCTORS
Reproducible adhesion test for soldered thick-film conductors
[AD-A054971] N78-31361

ELECTRIC CONNECTORS
Experimental determinations of temperatures and power losses at the electrical connections of some duplex receptacles
[PB-280071/2] N78-31378

ELECTRIC CURRENT
Electrical enhancement of healing in combat injuries to hard and soft tissues
[AD-A055531] N78-31718

ELECTRIC ENERGY STORAGE
Use of superconductive technology for energy storage and power transmission for large power systems: Power parks
[LA-UR-77-2805] N78-31581

ELECTRIC FIELDS
Dynamics of incommensurate charge density waves in electric and magnetic fields
N78-31911

ELECTRIC MOTOR VEHICLES
High performance metal/air fuel cells. Part 1: General review
[UCID-17558-PT-1] N78-31549

ELECTRIC MOTORS
Damper winding reactance
[AD-A055199] N78-31364

ELECTRIC OUTLETS
Experimental determinations of temperatures and power losses at the electrical connections of some duplex receptacles
[PB-280071/2] N78-31378

ELECTRIC POTENTIAL
Multi-KW dc distribution system technology research study
[NASA-CR-150789] N78-31353
TADIRAN high energy lithium batteries --- inorganic thionyl-chloride electrolytes
[LBR-1501] N78-31544

ELECTRIC POWER PLANTS
Solar central receiver power plants
[SAND-77-8510] N78-31550
Solar Pilot Plant, phase 1: Preliminary design report. Volume 7: Pilot plant cost, commercial plant cost and performance, CDRL item 2
[SAN-1109-8/9-VOL-7] N78-31574
Preliminary design manual for a geothermal demonstration plant at Herber, California
[EPRI-ER-670] N78-31575
Pollutant measurements in plumes from power plants and cities: A project MISTT report, summer 1975, February 1976, and February 1977
[PB-280198/3] N78-31609
Proposed issuance of a new source National Pollutant Discharge Elimination System Permit No. IA-0060909 to Iowa Southern utilities company, Ottumwa generating station for discharge of wastewaters to the Des Moines River near Ottumwa, Iowa
[PB-280369/0] N78-31617

ELECTRIC POWER SUPPLIES
Multi-KW dc distribution system technology research study
[NASA-CR-150789] N78-31353
Study of hybrid power structures
[ESA-CR[P]-1075] N78-31375

ELECTRIC POWER TRANSMISSION
Microwave electric power transmission. A bibliography with abstracts
[NTIS/PS-78/0580/7] N78-31379

ELECTRIC STIMULI
Electroreceptors in man and other animals
N78-31696

ELECTRIC WIRE
Method of moment thin wire computer program comparisons for complex structures and coarse accuracy
[AD-A055759] N78-31341
Monolithic 20W 2GHz transistor and monolithic 5W 4GHz transistor
[AD-A055249] N78-31360

ELECTRICAL INSULATION
Insulation techniques in high voltage high power converters
[ESA-CR[P]-1073] N78-31374

ELECTRICAL PROPERTIES
Electrical profiling of magnesium implanted gallium phosphide
[AD-A055195] N78-31929

ELECTRICAL RESISTANCE
Piezoresistivity and its magnetic field dependence in N-type indium-antimonide
N78-31914

ELECTRICAL RESISTIVITY
Development of solar reflector material with good electrical conductivity. Volume 1: Phase 1 study
[ESA-CR[P]-1069] N78-31180
Telluric and D. C. resistivity techniques applied to the geophysical investigation of basin and range geothermal systems
N78-31627

ELECTRO-OPTICS
Advanced optical blade tip clearance measurement system
[NASA-CR-159402] N78-31106
Electro-optical processing of signals and images
N78-31308

ELECTROCARDIOGRAPHY
Description and analysis of the Hewlett-Packard 78220 arrhythmia monitoring system
[AD-A055451] N78-31720

ELECTROCHEMICAL CORROSION
High temperature corrosion mechanics --- gas turbines alloys
N78-31231

ELECTROCHEMISTRY
Dedicated computer control of chemical instrumentation
[AD-A055268] N78-31190
TADIRAN high energy lithium batteries --- inorganic thionyl-chloride electrolytes
[LBR-1501] N78-31544

ELECTRODES
Potentiometric titration with EDTA using metallic bismuth indicator electrode
[ANL-TRANS-1123] N78-31198

ELECTROENCEPHALOGRAPHY
Neurophysiological assessment of functional states of the brain --- electroencephalographic responses to workloads
N78-31755

ELECTROMAGNETIC ABSORPTION
Electromagnetic penetration depth in superconducting alloys containing magnetic impurities
[COO-1198-1193] N78-31868

ELECTROMAGNETIC FIELDS
Coagulative properties of blood and tissues of the cardiovascular system in exposure to electromagnetic fields
N78-31706

ELECTROMAGNETIC NOISE
A random point process model for atmospheric radio noises
[AD-A055123] N78-31326

ELECTROMAGNETIC PULSES
Walsh adaptive filter
[AD-A055170] N78-31328
A wire passing by a circular aperture in an infinite ground plane
[AD-A055583] N78-31340

ELECTROMAGNETIC RADIATION
Resonant scattering of electromagnetic radiation from non-spherical optically anisotropic targets with axial symmetry
N78-31322
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 40. Effects on nonionizing electromagnetic radiation
[JPRS-71595] N78-31705

ELECTROMAGNETIC SCATTERING
Resonant scattering of electromagnetic radiation from non-spherical optically anisotropic targets with axial symmetry
N78-31322

ELECTROMAGNETIC WAVE FILTERS
SAW filter application for phased array radar
N78-31300

ELECTROMAGNETIC WAVE TRANSMISSION
Propagation model [0.1 to 20 GHz] extensions for 1977 computer programs
[AD-A055605] N78-31324
Backus-Gilbert inversion of electromagnetic propagation phenomena for remote probing of the atmosphere
[DLR-IB-551-76/21] N78-31346

ELECTRON BEAMS
Microwave surface-acoustic-wave components
N78-31283
IC fabrication using electron-beam technology
[AD-A055610] N78-31368
REB focusing in a high-voltage diode --- pulsed electron accelerators
[SAND-78-6005] N78-31883

ELECTRON DIFFRACTION
Electron spectroscopy and low-energy electron diffraction studies of silicon and titanium oxide surfaces
N78-31915

ELECTRON ENERGY
The excitation of electronic transverse energy levels in an intense magnetic field
N78-31996

ELECTRON IMPACT
Experimental studies of electron impact depopulation of excited states of atoms: Application to laser development for fusion and isotope separation
[COO-4199-1] N78-31884

ELECTRON IRRADIATION
Proton and electron irradiation of thermal control coatings and polymeric films. Part 1: Experimental part
[ESA-CR[P]-1077-VOL-1] N78-31252
Proton and electron irradiation of thermal control coatings and polymeric films. Part 2: Theoretical part
[ESA-CR[P]-1077-VOL-2] N78-31253
Deep level trap spectroscopy of gallium arsenide
[AD-A055198] N78-31933

ELECTRON MICROSCOPES
Strain induced plastic-to-rubber transition of an SBS block copolymer and its blend with PS
[AD-A055905] N78-31246

**ELECTRON MICROSCOPY**
Structure of gain boundaries in silicon nitride based alloys f-- electron microscopy of MgO, Y2O3, and magnesium-sialon
[LBL-6985] N78-31177
Characterizing high-energy-formed particulates with the scanning electron microscope/energy dispersive spectrometer system
[UCID-17652] N78-31266
Direct observation of grain boundary diffusion by scanning Auger microscopy --- scanning electron microscopy of metal films
[COO-2679-14] N78-31935
**ELECTRON MOBILITY**
Dynamics of incommensurate charge density waves in electric and magnetic fields
N78-31911
**ELECTRON PARAMAGNETIC RESONANCE**
Transition metal ion binding by ferritin as studies by electron paramagnetic resonance spectroscopy
N78-31184
**ELECTRON RECOMBINATION**
Radiolysis studies on reactive intermediates --- tunneling and diffusive recombination of solvated electrons
[COO-2086-88] N78-31200
**ELECTRON SCATTERING**
Electron scattering rate anisotropy and conduction electron-4f moment interactions Au[rare earth] dilute alloys
N78-31920
**ELECTRON SOURCES**
GEODSS experimental test system participation in Project EXCEDE --- tracking optical emissions induced in the atmosphere by an energetic electron source
[AD-A055264] N78-31642
**ELECTRON SPECTROSCOPY**
Electron spectroscopy and low-energy electron diffraction studies of silicon and titanium oxide surfaces
N78-31915
**ELECTRON STATES**
Statistical properties of particles confined by irregular surfaces
N78-31918
Deep level trap spectroscopy of gallium arsenide
[AD-A055198] N78-31933
**ELECTRON TRANSITIONS**
Quantum theory of cyclotron resonance lineshape for the inversion layer electrons in Metal-Oxide-Semiconductor [MOS]
N78-31925
The excitation of electronic transverse energy levels in an intense magnetic field
N78-31996
**ELECTRON TUNNELING**
Radiolysis studies on reactive intermediates --- tunneling and diffusive recombination of solvated electrons
[COO-2086-88] N78-31200
Electron tunneling into the A15 superconductors: Nb3Sn, V3Si, and Nb3Ge
N78-31924
**ELECTRONIC CONTROL**
Digital spectrometer scan controller
[COO-913-67] N78-31409
**ELECTRONIC COUNTERMEASURES**
Performance in a jamming environment of a low-cost GRS user receiver algorithm for aiding a tactical INS
[AD-A055239] N78-31078
**ELECTRONIC MODULES**
A modular adaptive, variable function flight control sensor
[AD-A055175] N78-31120
**ELECTRONS**
Reaction rate data, number 61
[AD-A055983] N78-31644
**ELECTROPHORESIS**
Analytical study of electrophoretic characterization of kidney cells --- conducted during the Apollo Soyuz Test Project
[NASA-CR-150790] N78-31713
**ELECTROPHYSIOLOGY**
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 35
[JPRS-71467] N78-31694
Electroreceptors in man and other animals
N78-31696
**ELECTROSLAG REFINING**
Solidification of electroslag remelted low alloy steel ingots
[AD-A055576] N78-31221
**EMERGENCY LIFE SUSTAINING SYSTEMS**
GPSS computer simulation of aircraft passenger emergency evacuations
[AD-A056098] N78-31062
**EMISSION SPECTRA**
Spectral and total emissivity and reflectivity at high temperatures
[AD-A055027] N78-31191
A study of the diffusion of tracer impurities in the Versator 1 Tokamak plasma by spectral emissions in the vacuum ultraviolet range
[AD-A054756] N78-31906
Gamma ray spectroscopy in astrophysics --- conferences
[NASA-TM-79619] N78-31971
Mechanisms and sites for astrophysical gamma ray line production
N78-31972
Gamma ray spectroscopy in astrophysics: An observational overview [50 keV-20 MeV]
N78-31973
Gamma ray emission and solar flares
N78-31975
Planetary gamma-ray spectroscopy
N78-31976
The galactic gamma-ray flux in the 0.06 to 5 MeV range
N78-31979
Search for broad gamma ray lines with the UCR double Compton scatter telescope
N78-31981
Nuclear gamma rays from compact objects --- nuclear interactions around neutron stars and black holes
N78-31984
Gamma-ray lines form neutron stars as probes of fundamental physics
N78-31985
Galactic center iron line emission
N78-31987
Gamma ray lines from novae --- stellar mass ejection
N78-31989
Gamma-ray line emission above 8 MeV
N78-31990
Upper limits on the cyclotron lines from Her X-1 as observed with OSO-8
N78-31993
HEAO-1 observations of Her X-1 at energies above 13 keV
N78-31924
Cyclotron emission in neutron star magnetospheres
N78-31995
The excitation of electronic transverse energy levels in an intense magnetic field
N78-31996
Theory of the accretion column and cyclotron radiation in X ray pulsars
N78-31998
Future directions in experimental gamma ray astronomy --- technology assessment
N78-32005
**ENCAPSULATING**
Incapsulation and annealing of ion implanted selenium in GaAs
N78-31919
**ENERGETIC PARTICLES**
The energetic particle environment of the solar probe mission: As estimated by the participants of the Solar Probe Environment Workshop
[NASA-CR-157595] N78-32032
**ENERGY ABSORPTION**
Energy quality of humidity and thermal advection of air in Florida
N78-31567
**ENERGY BUDGETS**
Design definition study of the Earth radiation budget satellite system
[NASA-CR-158934] N78-31140
**ENERGY CONSERVATION**
Initial test results with a single-cylinder rhombic-drive Stirling engine --- to be applied to automobile engine design to conserve energy
[NASA-TM-78919] N78-31533
Some aspects of energy use in housing
N78-31570
**ENERGY CONSUMPTION**
JPL Energy Consumption Program [ECP] documentation: A computer model simulating, heating, cooling and energy loads in buildings --- low cost solar array efficiency
[NASA-CR-157599] N78-31541
Energy analysis of models of the United States, narrative
N78-31556
Energy analysis, energy quality, and environment
N78-31558
Energy-quality calculations for freshwater chemical potential
N78-31566
Statistical test of energy models for prediction of urban growth in Florida
N78-31569
Some aspects of energy use in housing
N78-31570
Energy analysis and model of intermediate agriculture
N78-31571
Integrating policy analysis: Study module 7. Volume 2: Technical appendix
[PB-280037/3] N78-31587
**ENERGY CONVERSION**
Conversion of trash to gasoline
[AD-A055113] N78-31257
**ENERGY CONVERSION EFFICIENCY**
Energy efficient engine: Preliminary design and integration studies
[NASA-CR-135444] N78-31108
Efficiency and investment matching of high quality energy
N78-31560
Energy analysis and models of soil formation
N78-31564
**ENERGY DISSIPATION**
Energy losses in high energy rocket engines with thrust variation
[DLR-FB-77-41] N78-31166
**ENERGY DISTRIBUTION**
Energy diagrams of published energy analysis of others
N78-31561
A meso-model of the economy of the United States for comparison of economic and energetic analysis
N78-31562
A historic and current energy analysis of Florida
N78-31568
**ENERGY LEVELS**
Description of the MILSATCOM loading program OPAL
[AD-A054878] N78-31144
User's guide for the MILSATCOM loading program OPAL
[AD-A054879] N78-31145
Description of the MILSATCOM loading program OPAL, GPSCS addendum
[AD-A054880] N78-31146
User's guide for the MILSATCOM loading program OPAL, GPSCS addendum
[AD-A054881] N78-31147
**ENERGY POLICY**
Survey and analysis of selected topics within the Energy Research and Development Administration's [ERDA] materials research and development programs
[DOE/ET-0006] N78-31170
Automotive diesel technology program --- computerized design
[SAN-1099-1] N78-31436
The outlook for automotive fuel supplies, alternative vehicle engines, and potential implications for transportation tax structures [1985-2000]
[PB-279679/5] N78-31440
Solar pond
[NASA-CASE-NPO-13581-2] N78-31525
Non-tracking solar energy collector system
[NASA-CASE-NPO-13813-1] N78-31526
Coal desulfurization process
[NASA-CASE-NPO-13937-1] N78-31527
Energy: A continuing bibliography with indexes, issue 17
[NASA-SP-7043(17)] N78-31530
Solar heating and cooling systems design and development --- prototype development
[NASA-CR-150770] N78-31532
Design and installation package for the Sunmat Flat Plate solar collector
[NASA-CR-150741] N78-31536
Applications of thermal energy storage to process heat storage and recovery in the paper and pulp industry
[NASA-CR-159398] N78-31537
Design data brochure: Solar hot water system
[NASA-CR-150699] N78-31538
Greenbelt Community Project: Solar energy retrofit for a multi-family dwelling
[NASA-TM-79612] N78-31539
JPL Energy Consumption Program [ECP] documentation: A computer model simulating, heating, cooling and energy loads in buildings --- low cost solar array efficiency
[NASA-CR-157599] N78-31541
Briefing on Department of Energy --- management of energy programs
[GPO-20-083] N78-31542
Environmental challenges of the President's energy plan: Implications for research and development
[GPO-96-834] N78-31543
High output solar cell with multilayer AR coating
[AD-A054226] N78-31545
Design and cost study for development of lead-acid batteries suitable for electric vehicle propulsion
[ANL-K-77-3624-1] N78-31548
Solar central receiver power plants
[SAND-77-8510] N78-31550
Design and cost study of a nickel-iron oxide battery for electric vehicles. Volume 2: Public report
[ANL-K-3723-1] N78-31551
Thermal and kinetic analysis of the pyrolysis of coals
[EPRI-AF-528] N78-31552
Hot dry rock, an alternate geothermal energy resource: A challenge for instrumentation
[LA-UR-78-707] N78-31553
Assessment of low- and intermediate-Btu gasification of coal
[FE-1216-4] N78-31554
Energy analysis of models of the United States
N78-31555
Energy analysis of models of the United States, narrative
N78-31556
Energy analysis of models of the United States, a summary of progress
N78-31557

Energy analysis, energy quality, and environment
N78-31558
Energy models of exchange with simulation of the role of exchange in spatial organization
N78-31559
Efficiency and investment matching of high quality energy
N78-31560
Energy diagrams of published energy analysis of others
N78-31561
A meso-model of the economy of the United States for comparison of economic and energetic analysis
N78-31562
Comparison of energy analysis of oil shale
N78-31563
Energy-quality calculations for freshwater chemical potential
N78-31566
Statistical test of energy models for prediction of urban growth in Florida
N78-31569
Some aspects of energy use in housing
N78-31570
Energy analysis and model of intermediate agriculture
N78-31571
Energy analysis of Brazil
N78-31572
Quality assurance program document for 75 mW radioisotope thermoelectric generator program
[GA-A-14807] N78-31573
Solar Pilot Plant, phase 1: Preliminary design report. Volume 7: Pilot plant cost, commercial plant cost and performance, CDRL item 2
[SAN-1109-8/9-VOL-7] N78-31574
Preliminary design manual for a geothermal demonstration plant at Herber, California
[EPRI-ER-670] N78-31575
Double-exposure collector system
[TID-28291] N78-31576
Giromill wind tunnel test and analysis. Volume 1: Executive summary
[COO-2617-4/1-VOL-1] N78-31579
Performance evaluation of wind energy conversion systems using the method of bins: Current status
[SAND-77-1375] N78-31580
Use of superconductive technology for energy storage and power transmission for large power systems: Power parks
[LA-UR-77-2805] N78-31581
Form-stable crystalline polymer pellets for thermal energy storage, phase 1
[ORO-5159-10] N78-31582
Continuation study of the potential for solar heating of buildings in Canada
[NP-23162] N78-31583
Energy analysis and oil shale reserves
[ERG-023] N78-31584
Integrating policy analysis: Study module 7. Volume 2: Technical appendix
[PB-280037/3] N78-31587
Cleaning coal with coal: Coal humic acids for removal of acids, alkali, salinity, and heavy metal pollutants associated with the use of coal as a fuel
[PB-280580/2] N78-31608
Control techniques for nitrogen oxides emissions from stationary sources - second edition
[PB-280034/0] N78-31612
Burner design criteria for NOx control from low-BTU gas combustion: Volume 2. Elevated fuel temperature
[PB-280199/1] N78-31615

**ENERGY REQUIREMENTS**
Alternate power sources session: Nuclear battery hybrid configuration study
[AD-A055182] N78-31546
Analysis of nuclear systems satisfying US energy needs
[GA-A-14848] N78-31891

**ENERGY SOURCES**
Energy analysis of models of the United States
N78-31555
Energy analysis of models of the United States, narrative
N78-31556
Energy analysis of models of the United States, a summary of progress
N78-31557
Energy analysis, energy quality, and environment
N78-31558
Energy models of exchange with simulation of the role of exchange in spatial organization
N78-31559
Efficiency and investment matching of high quality energy
N78-31560
Energy diagrams of published energy analysis of others
N78-31561
Comparison of energy analysis of oil shale
N78-31563
A historic and current energy analysis of Florida
N78-31568
Energy analysis of Brazil
N78-31572

**ENERGY SPECTRA**
Detection of 511 keV positron annihilation radiation from the galactic center direction --- gamma ray astronomy
N78-31978
Low energy gamma ray observations with the MPI-Compton telescope --- balloon-borne detectors
N78-31980
Cross sections relevant to gamma ray astronomy
N78-32006

**ENERGY STORAGE**
A variable inertia flywheel as an energy storage system
N78-31529
Applications of thermal energy storage to process heat storage and recovery in the paper and pulp industry
[NASA-CR-159398] N78-31537
Energy analysis and models of soil formation
N78-31564
Physical properties data compilations relevant to energy storage. 1. Molten salts: Eutectic data --- bibliography
[PB-280795/6] N78-31589

**ENERGY TECHNOLOGY**
Survey and analysis of selected topics within the Energy Research and Development Administration's [ERDA] materials research and development programs
[DOE/ET-0006] N78-31170
Hot dry rock, an alternate geothermal energy resource: A challenge for instrumentation
[LA-UR-78-707] N78-31553
State-of-the-art reviews and bibliographies on energy. A bibliography with abstracts
[NTIS/PS-78/0586/4] N78-31586

**ENERGY TRANSFER**
Applications of thermal energy storage to process heat storage and recovery in the paper and pulp industry
[NASA-CR-159398] N78-31537
Energy models of exchange with simulation of the role of exchange in spatial organization
N78-31559
Energy analysis of order-disorder phenomenon of man and nature
N78-31565
Energy quality of humidity and thermal advection of air in Florida
N78-31567
A historic and current energy analysis of Florida
N78-31568
Statistical test of energy models for prediction of urban growth in Florida
N78-31569
Atmospheric CO2 infrared background investigation. Experimental configuration of 2.7 to 4.3 micrometers fluorescence modeling of 4.3 micrometers spectral structure
[AD-A055943] N78-31643
Vibrational relaxation and energy transfer of matrix isolated HCl and DCl
[LBL-7344] N78-31885

**ENGINE CONTROL**
Alternatives for jet engine control
[NASA-CR-157578] N78-31107

**ENGINE DESIGN**
Energy efficient engine: Preliminary design and integration studies
[NASA-CR-135444] N78-31108
Orbit Transfer Vehicle [OTV] engine phase A study
[NASA-CR-150796] N78-31163
Liquid rocket engine axial-flow turbopumps
[NASA-SP-8125] N78-31164
Engineering design data and correlations for nitinol devices --- austenitic martensitic phase transformations
N78-31206
Automotive diesel technology program --- computerized design
[SAN-1099-1] N78-31436
Initial test results with a single-cylinder rhombic-drive Stirling engine --- to be applied to automobile engine design to conserve energy
[NASA-TM-78919] N78-31533

**ENGINE FAILURE**
Rotor burst protection program: Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1975
[NASA-CR-135304] N78-31105

**ENGINE PARTS**
Turbine tip clearance measurement
[AD-A055765] N78-31115
TF30 third-stage composite fan blade service program
[AD-A055891] N78-31174

**ENGINE TESTS**
Initial test results with a single-cylinder rhombic-drive Stirling engine --- to be applied to automobile engine design to conserve energy
[NASA-TM-78919] N78-31533

**ENGINEERING DRAWINGS**
Reliability in the design of welded structures
N78-31438
An adaptive recognition algorithm for the automatic detection of straight line segments
N78-31787

**ENTROPY**
Modified maximum entropy spectral analysis of bandlimited signals in lowpass noise
[AD-A055258] N78-31331

**ENVIRONMENT EFFECTS**
Effect of handling procedures on sample quality --- organic compounds
[PB-279910/4] N78-31204
The influence of the environment on the elastoplastic properties of adhesives in metal bonded joints --- in aircraft structures
[DLR-FB-77-63] N78-31251
Environmental effects on fatigue of aluminium and titanium alloys
[NLR-MP-77019-U] N78-31463
Environmental challenges of the President's energy plan: Implications for research and development
[GPO-96-834] N78-31543
Federal noise research in noise effects
[PB-280335/1] N78-31733

**ENVIRONMENT MANAGEMENT**
Risk analysis in environmental studies. 1: Risk analysis methodology, a statistical approach. 2: Data management for environmental studies
[RHO-SA-33] N78-31597

**ENVIRONMENT MODELS**
Energy analysis of models of the United States
N78-31555
Energy analysis of models of the United States, narrative
N78-31556
Energy analysis of models of the United States, a summary of progress
N78-31557
Energy analysis, energy quality, and environment
N78-31558
A historic and current energy analysis of Florida
N78-31568
Energy analysis and model of intermediate agriculture
N78-31571

**ENVIRONMENT PROTECTION**
A literature review: Problem definition studies on selected toxic chemicals. Volume 6: Occupational health and safety and environmental aspects of urea-formaldehyde resins
[AD-A054991] N78-31716

**ENVIRONMENT SIMULATION**
Simulation of the urban neutral boundary layer for the model study of wind loads on tall buildings
[PB-280787/3] N78-31278

**ENVIRONMENTAL MONITORING**
Surface hydrodynamical models through synoptic interpretation of LANDSAT MSS images in lagoonal and coastal waters
[E78-10188] N78-31487
Remote sensing applications to Missouri environmental resources information system
[E78-10209] N78-31507
An evaluation of the first four LANDSAT-D thematic mapper reflective sensors for monitoring vegetation: A comparison with other satellite sensor systems
[NASA-TM-79617] N78-31510

**ENVIRONMENTAL SURVEYS**
Proposed issuance of a new source National Pollutant Discharge Elimination System Permit No. IA-0060909 to Iowa Southern utilities company, Ottumwa generating station for discharge of wastewaters to the Des Moines River near Ottumwa, Iowa
[PB-280369/0] N78-31617
Highway traffic noise. A bibliography with abstracts
[NTIS/PS-78/0634/2] N78-31620
Massachusetts coastal zone management program and final environmental impact statement
N78-31681

**EPOXY RESINS**
System for vacuum pouring of epoxy tensile and impact specimens with a study of the behavior of these specimens at 77 K and 293 K
[ORNL-TM-5493] N78-31178
Activated gas reactions with silicone and epoxy resins
[SAND-77-1429C] N78-31201

**EQUATIONS OF MOTION**
Dynamics of a three degree of freedom kinematic chain
[AD-A055612] N78-31840
Development of a set of general rigid and flexible body equations of motion in coupled form using the direct approach
N78-31867

**EQUATIONS OF STATE**
New approximation equations for the saturation pressure of water vapor and for humidity parameters used in meteorology
[DLR-FB-77-52] N78-31679

**EQUILIBRIUM EQUATIONS**
Light on light: Satyendra Nath Bose's work on radiative equilibrium --- quantum statistics
[ORO-3992-307] N78-31942

**EQUIPMENT SPECIFICATIONS**
Tracking servobridge detectors, volume 2
[AD-A055084] N78-31357
**ERBIUM COMPOUNDS**
Stress-strain behavior of ERNiCr-3 weld filler metal under strain controlled cyclic loading
[ORNL-TM-6128] N78-31228
**ERROR ANALYSIS**
Inherent errors in asynchronous digital flight controls
[AD-A055649] N78-31124
Broadband modem II
[AD-A055269] N78-31334
A way to remove the bias of the chi-square test N78-31849
Comet Tempel 2: Orbit, ephemerides and error analysis
[NASA-CR-157598] N78-32018
**ERROR DETECTION CODES**
Various aspects for correcting and detecting syntactical errors in computer programs
[INPE-1063-NTE/098] N78-31791
Modeling of a latent fault detector in a digital system
[NASA-CR-145371] N78-31794
**ESCHERICHIA**
The 70 S monosome accumulation and in vitro initiation complex formation by Escherichia coli ribosomes at 5 C
[NASA-CR-157591] N78-31691
**ESTIMATING**
The human operator simulator: Workload estimation using a simulated secondary task N78-31756
**ETCHING**
RF plasma enhanced vapor deposition and etching of silicon nitride
[SAND-77-2070] N78-31176
**ETHYLENEDIAMINETETRAACETIC ACIDS**
Potentiometric titration with EDTA using metallic bismuth indicator electrode
[ANL-TRANS-1123] N78-31198
**EUCLIDEAN GEOMETRY**
Topics in computational geometry N78-31783
**EUROPEAN SPACE AGENCY**
Configuration management requirements --- for ESA spacecraft and associated equipment development
[ESA-SPEC-QRA-03-ISSUE-3] N78-31157
Standard parts list for ESA projects
[ESA-SPEC-QRC-04-ISSUE-1-REV-1] N78-31158
**EUROPEAN SPACE PROGRAMS**
Definition study of a multidisciplinary European mission. Volume 1: Executive summary
[ESS/SS-777] N78-31138
**EUTECTIC ALLOYS**
Longitudinal shear behavior of several oxide dispersion strengthened alloys
[NASA-TM-78973] N78-31211
Investigation of phase equilibria of TaC fiber reinforced cobalt alloys having a directionally solidified eutectic structure aimed at matrix hardening --- turbine blades
[DLR-FB-77-58] N78-31939
**EUTECTICS**
Physical properties data compilations relevant to energy storage. 1. Molten salts: Eutectic data --- bibliography
[PB-280795/6] N78-31589
**EUTROPHICATION**
Effects of diversion and alum application on two eutrophic lakes
[PB-280983/8] N78-31624
**EVACUATING [TRANSPORTATION]**
GPSS computer simulation of aircraft passenger emergency evacuations
[AD-A056098] N78-31062
**EVALUATION**
Evaluation and qualification of thick film hybrid microcircuits --- for space application
[ESA-SPEC-QRC-06-ISSUE-2-REV-1] N78-31376
**EXCITONS**
Nucleation phenomena in the formation electron-hole drops in Ge N78-31910
**EXHAUST GASES**
The influence of overall fuel-air ratio and degree of stratification on the fuel consumption and emissions of a prechamber, stratified-charge engine N78-31425
Mechanisms of exhaust pollutants and plume formation in continuous combustion
[AD-A054844] N78-31594
Physical and chemical phenomena responsible for odor formation in diesel engines
[PB-280544/8] N78-31621
**EXOBIOLOGY**
Aerospace medicine and biology: A continuing bibliography with indexes, supplement 183
[NASA-SP-7011(183)] N78-31712
**EXPERIMENTAL DESIGN**
The design and aerodynamic characteristics of the RAE 5215 aerofoil
[ARC-CP-1386] N78-31055
A hard X-ray and gamma ray observation of the 22 November 1977 solar flare --- experimental design N78-31974
HEAO C-1 gamma-ray spectrometer --- experimental design N78-32011
Gamma ray spectroscopy in astrophysics: Solar gamma ray astronomy on solar maximum mission --- experimental design N78-32012
**EXPLORATION**
Geothermal exploration techniques: A case study
[EPRI-ER-680] N78-31577
**EXPLOSIVE DEVICES**
A pressure limiting propellant actuating system
[NASA-CASE-MSC-18179-1] N78-31162
**EXPLOSIVES**
Development of an explosive slurry monitor
[AD-A054736] N78-31258
Determination of minimum non-propagation distance of aluminum buckets containing 15 pounds of composition A5 --- handling high explosives
[AD-A054737] N78-31259
Investigation of propellant and explosive solid solution systems II X-ray studies
[AD-A055981] N78-31263
High-temperature shock initiation of explosives
[LA-7158] N78-31267
**EXPONENTIAL FUNCTIONS**
Simulation study of the power of the Kolmogoroff-Smirnoff and Z tests for the exponential distribution
[NASA-TP-1311] N78-31854
**EXTERNAL COMBUSTION ENGINES**
Rotary expander engine development program
[AD-A055662] N78-31432
**EXTERNAL STORES**
Graphics for the hybrid stores separation simulation of the B77 system
[SAND-78-8212] N78-31099
**EXTRATERRESTRIAL RADIATION**
Observational evidence for extraterrestrial gamma-ray line sources N78-31983
**EXTRAVEHICULAR ACTIVITY**
Evolution of the space suit N78-31695
**EYE [ANATOMY]**
An experimental investigation of the effect of 1.06 micrometers laser light on the transparent ocular media
[AD-A055650] N78-31719
**EYE MOVEMENTS**
Methodological considerations of visual workloads of helicopter pilots --- eye movement measurements N78-31747

## F

**F REGION**
On the relative location of the plasmapause and the HF backscatter curtains
[REPT-23] N78-31636
**F-4 AIRCRAFT**
Results of a wind tunnel and flight test program to develop a Maximum Volume Bomb [MVB configuration for multiple carriage and separation from tactical-aircraft at mach numbers from 0.50 to 1.10
[AD-A055029] N78-31051
**F-15 AIRCRAFT**
Hazard assessment of aircraft gun compartments
[AD-A055026] N78-31064
**F-16 AIRCRAFT**
Status of the Air Force's F-16 aircraft program
[PB-280304/7] N78-31946
**FABRICATION**
Fabrication and mechanical properties of alumina fiber-alumina matrix composites N78-31171
Development of plating thickness standards
[BDX-613-1709-REV] N78-31272
Microwave surface-acoustic-wave components N78-31283
Experiments and analysis of acoustoelectric memory correlators N78-31296
**FAILURE ANALYSIS**
Hybrid microcircuit failure rate prediction
[AD-A055756] N78-31367
Smoothing magic in renewal theory N78-31834
**FALLING SPHERES**
Measurements of atmospheric density at Kwajalein Atoll, 18 May 1977
[AD-A054784] N78-31640
**FANS**
Ground impingement of a fan jet exhaust plume
[AD-A054832] N78-31112
**FAR INFRARED RADIATION**
Optical difference frequency generation of far infrared radiation N78-31895
**FAR ULTRAVIOLET RADIATION**
A study of the diffusion of tracer impurities in the Versator 1 Tokamak plasma by spectral emissions in the vacuum ultraviolet range
[AD-A054756] N78-31906
**FARM CROPS**
Atlas of selected crop spectra, Imperial Valley, California
[E78-10201] N78-31499
**FAST FOURIER TRANSFORMATIONS**
Exact fermat number transform convolution with comparison to fast Fourier transform techniques N78-31762
**FASTENERS**
Flaw growth in complex structure. Volume 2: Test data
[AD-A054744] N78-31430
Residual strength tests on fatigue-cracked multi-fastener specimens of extruded L.65 aluminum alloy
[ARL-STRUC-NOTE-444] N78-31458
**FATIGUE [MATERIALS]**
Determination of fatigue performance data on structural materials under typified random loading: Axially loaded notched specimens of mild steel RR St 52 - 3 [SAE 1030]
[TB-127(1978)] N78-31461
Time series determination of transfer functions in random fatigue
[AD-A055656] N78-31471
An interactive program for the analysis of fatigue data N78-31476
**FATIGUE LIFE**
Review of the AGARD S and M panel evaluation program of the NASA-Lewis SRP approach to high-temperature LCF life prediction
[NASA-TM-78879] N78-31209
Cyclic ductility cyclic strength and fatigue crack propagation of metals and alloys
[AD-A055359] N78-31220
Elevated temperature creep and fatigue damage of a 2.25 Cr-1 Mo steel weldment
[SAND-77-1556] N78-31229
Laboratory for fatigue life evaluation research reports, issue 8
[ICAF-1045] N78-31460
Determination of fatigue performance data on structural materials under typified random loading: Axially loaded notched specimens of mild steel RR St 52 - 3 [SAE 1030]
[TB-127(1978)] N78-31461
Investigation to compute the distribution of fatigue life by Monte-Carlo methods
[FB-138(1978)] N78-31462
**FATIGUE TESTS**
Alternating tension-compression fatigue strength and property changes of steel after cold deformation at different deformation rates
[RAE-LIB-TRANS-1967] N78-31207
Correlation of low-cycle and high-cycle fatigue data for solution-annealed Incoloy-800
[BNL-NUREG-23776] N78-31222
Stress-strain behavior of ERNiCr-3 weld filler metal under strain controlled cyclic loading
[ORNL-TM-6128] N78-31228
Rolling element fatigue testing of gear materials
[NASA-CR-135411] N78-31427
Flaw growth in complex structure. Volume 2: Test data
[AD-A054744] N78-31430
Reliability in the design of welded structures N78-31438
Constant-amplitude and program-load fatigue tests at low cyclic frequencies on thick aluminium alloy pin joints
[ARL-STRUC-REPT-365] N78-31457
Laboratory for fatigue life evaluation research reports, issue 8
[ICAF-1045] N78-31460
Environmental effects on fatigue of aluminium and titanium alloys
[NLR-MP-77019-U] N78-31463
Time series determination of transfer functions in random fatigue
[AD-A055656] N78-31471
**FAULTS**
Modeling of a latent fault detector in a digital system
[NASA-CR-145371] N78-31794
**FEASIBILITY ANALYSIS**
The laser lightning rod system: A feasibility study
[AD-A055255] N78-31417
**FEDERAL BUDGETS**
Department of Housing and Urban Development, and certain independent agencies appropriations for fiscal year 1979, part 2
[GPO-23-600] N78-31956
**FEEDBACK CONTROL**
Inherent errors in asynchronous digital flight controls
[AD-A055649] N78-31124

Digital controller design: Analysis of the annular suspension pointing system --- analog controllers with feedback
[NASA-CR-150807] N78-31825
An analysis of observed system sensitivity to plant parameter variations
[AD-A055190] N78-31829
FERRITES
A survey of properties of latched non-reciprocal ferrite phase shifters with cylindrical rods at 3, 5.5, 9.3, and 16 GHz
[PHL-1977-39] N78-31373
FERROUS METALS
Lithium compatibility research: Status and requirements for ferrous materials
[CONF-780308-6] N78-31224
FIBER OPTICS
Development of an explosive slurry monitor
[AD-A054736] N78-31258
FIBER ORIENTATION
The interrelationships of density and fiber orientation on the mechanical properties of fiberboard
N78-31172
FIBERS
Development and fabrication of a prototype Fibrous Aerosol Monitor [FAM]
[PB-280126/4] N78-31613
FIELD EMISSION
Spacecraft charging control by thermal, field emission with lanthanum-hexaboride emitters
[NASA-TM-78990] N78-32014
FIELD THEORY [PHYSICS]
The dynamic theory, a new view of space, time, and matter
[AD-A055325] N78-31941
FIGHTER AIRCRAFT
The terrain following task for the advanced tactical fighter using discrete optimal control
[AD-A055196] N78-31121
FILLING
Filling of orbital fluid management systems
[NASA-CR-159404] N78-31380
FILM CONDENSATION
An experimental investigation of enhanced heat transfer on horizontal condenser tubes
[AD-A055430] N78-31392
FILM COOLING
Analysis of metal temperature and coolant flow with a thermal-barrier coating on a full-coverage-film-cooled turbine vane
[NASA-TP-1310] N78-31109
FILM THICKNESS
Development of plating thickness standards
[BDX-613-1709-REV] N78-31272
FINANCIAL MANAGEMENT
Preliminary findings and views concerning the exemption of aviation gasoline from the mandatory petroleum allocation and price regulations
[DOE/ERA-0001] N78-31957
Preliminary findings and views concerning the exemption of kerojet fuels from the mandatory petroleum allocation and price regulations
[DOE/ERA-0002] N78-31958
FINITE ELEMENT METHOD
Development of a three-dimensional model of the atmospheric boundary layer using the finite element method
[UCRL-52366] N78-31652
FIRE CONTROL
An extended Kalman filter fire control system against air-to-air missiles volume 1
[AD-A055179] N78-31090
FIRE DAMAGE
Development of a data base for assessing plastic fire hazards
[PB-280027/4] N78-31254
FIRE PREVENTION
Antimisting fuel spillage/airshear tests at Naval Weapons Center
[AD-A056113] N78-31256
A statistical sampling of cities: Current and projected involvement in fire prevention and control master planning
[PB-279922/9] N78-31963
FIRING [IGNITING]
A technique for evaluating fuel and hydraulic fluid ballistic vulnerability
[AD-A055058] N78-31188
FISHES
Deep Ocean Mining Environmental Study [DOMES]. Unpublished manuscript number 20. Data report: Trace metals - DOMES samples
[PB-281098/4] N78-31687
Behavior, ecology and toxicity of venomous marine fishes
[AD-A054925] N78-31692
FLAKES
Critical depth tests of bulk TNT flake explosive --- conveyors for handling explosives safely
[AD-A054739] N78-31260
FLAME STABILITY
Flame stabilization in a ramjet combustion chamber by means of a pilot gas generator
[DLR-FB-77-54] N78-31117
FLAMMABILITY
Development of a data base for assessing plastic fire hazards
[PB-280027/4] N78-31254
Hazards of organic working fluids
[BNL-50761] N78-31725
FLAMMABLE GASES
Hazard assessment of aircraft gun compartments
[AD-A055026] N78-31064
Numerical analysis of flow fields generated by accelerating flames
[LBL-7233] N78-31199
FLARE STARS
Nuclear gamma rays from stellar flares
N78-31977
FLAT PLATES
Transient behavior of solid sensible heat thermal energy storage units
N78-31528
Design and installation package for the Sunmat Flat Plate solar collector
[NASA-CR-150741] N78-31536
A study of the structural-acoustic response and interior noise levels of fuselage structures
[NASA-CR-157589] N78-31872
FLEXIBLE BODIES
Development of a set of general rigid and flexible body equations of motion in coupled form using the direct approach
N78-31867
FLIGHT CONTROL
A modular adaptive, variable function flight control sensor
[AD-A055175] N78-31120
The terrain following task for the advanced tactical fighter using discrete optimal control
[AD-A055196] N78-31121
Optimal terrain following controller for an optimized spline reference path
[AD-A055234] N78-31122
The influence of throttle augmented stability [APCS] and short period control characteristics on the landing approach
[AD-A055892] N78-31123
Inherent errors in asynchronous digital flight controls
[AD-A055649] N78-31124
FLIGHT CREWS
Methods to assess work load
[AGARD-CP-216] N78-31745
Is man the weakest link? --- real time activity recording of aircrew workloads
N78-31746
Operator workload assessment model: An evaluation of a VF/VA-V/STOL system
N78-31757
Mathematical analysis and computer simulation in military mission workload assessment
N78-31758
FLIGHT INSTRUMENTS
A modular adaptive, variable function flight control sensor
[AD-A055175] N78-31120
FLIGHT OPTIMIZATION
Trajectory optimization for some sailplane performance problems
N78-31083
FLIGHT PATHS
Optimal terrain following controller for an optimized spline reference path
[AD-A055234] N78-31122
FLIGHT PLANS
IFR aircraft handled forecast by air route traffic control center, fiscal years 1978-1989
[AD-A049305] N78-31075
FLIGHT RECORDERS
Preliminary design of an accident Information Retrieval System [AIRS]
[AD-A055590] N78-31952
FLIGHT SIMULATION
Simulation and flight evaluation of a head-up landing aid for general aviation
[NASA-TP-1276] N78-31101
Software design for a Visually-Coupled Airborne Systems Simulator [VCASS]
[AD-A055226] N78-31133
A pilot evaluation of two G-seat cueing schemes
[NASA-TP-1255] N78-31739
FLIGHT SIMULATORS
Software design for a Visually-Coupled Airborne Systems Simulator [VCASS]
[AD-A055226] N78-31133
Experimental test plan for the evaluation of aircraft separation assurance displays using airline flight simulators
[AD-A055849] N78-31134
US Navy fleet aviation training program development
[AD-A055788] N78-31734
FLIGHT STRESS
Use of Inspiratory Minute Volumes in evaluation of rotary and fixed wing pilot workload --- respiratory response to flight conditions
N78-31754
FLIGHT TESTS
Results of a wind tunnel and flight test program to develop a Maximum Volume Bomb [MVB configuration for multiple carriage and separation from tactical-aircraft at mach numbers from 0.50 to 1.10
[AD-A055029] N78-31051
Loran-C flight test software
[NASA-CR-157581] N78-31069
TRSB microwave landing system demonstration program at Kristiansand, Norway
[AD-A055317] N78-31071
TRSB microwave landing system demonstration program at Charleroi, Belgium
[AD-A055920] N78-31072
IPC design validation and flight testing
[AD-A055529] N78-31074
Evaluation of AAFE apparatus to measure residual and transient convection in zero-gravity
[NASA-TM-78191] N78-31382
FLIGHT TRAINING
Antitorque training: Evaluation of effectiveness in reducing mishap losses
[AD-A055040] N78-31092
US Navy fleet aviation training program development
[AD-A055788] N78-31734
FLOATS
Rotating arm experiments for the stable semi-submerged platform [SSP] manuevering predictions
[AD-A055721] N78-31434
FLORIDA
A historic and current energy analysis of Florida
N78-31568
Statistical test of energy models for prediction of urban growth in Florida
N78-31569
Cypress wetlands for water management, recycling and conservation
[PB-282159/3] N78-31970
FLOW CHARACTERISTICS
The determination of the Laval nozzle exit conditions at too high counterpressure, especially for a propane oxygen gas generator
[DLR-FB-77-45] N78-31057
Factors determining maximal expiratory flows in the human lung
N78-31711
FLOW CHARTS
An automated procedure for computing the three-dimensional transonic flow over wing-body combustions, including viscous effects. Volume 2: Program user's manual and code description. Appendix A: Computer code listing and flowchart
[AD-A055109] N78-31050
FLOW DEFLECTION
Deflection of a transversely loaded spinning disk
N78-31455
FLOW DISTRIBUTION
Laminar flow-field computation in axisymmetric nozzles
[RAE-TR-77175] N78-31059
Numerical analysis of flow fields generated by accelerating flames
[LBL-7233] N78-31199
FLOW MEASUREMENT
Measurement techniques and applications of charge transfer to aerospace research
[NASA-TM-78734] N78-31404
FLOW VISUALIZATION
Measurements and analysis of the forces acting on a small aircraft flying in the upwash of a large aircraft
[AD-A055286] N78-31048
FLUES
Flue gas desulfurization systems: Design and operating considerations. Volume 1: Executive summary
[PB-280253/6] N78-31598
Flue gas desulfurization systems: Design and operating considerations. Volume 2: Technical report
[PB-280254/4] N78-31599
FLUID FLOW
Discharge measurement structures
[PUBL-161] N78-31395
FLUID MECHANICS
Draining characteristics of hemispherically bottomed cylinders in a low-gravity environment
[NASA-TP-1297] N78-31384
Instability, transition to turbulence and predictability
[AGARD-AG-236] N78-31401
FLUIDICS
An evaluation of the fluidic oxygen partial pressure sensor
[AD-A055362] N78-31743
FLUORESCENCE
Studies in fluorescence spectroscopy
N78-31182
Feasibility of using fluorescent materials in product assurance applications and for locating adhesive bond fractures
[AD-A055979] N78-31245
Atmospheric CO2 infrared background investigation. Experimental configuration of 2.7 to 4.3

micrometers fluorescence modeling of 4.3 micrometers spectral structure
[AD-A055943] N78-31643
FLUORINATION
Fundamental studies of metal fluorination reactions
[COO-2671-7] N78-31202
FLUORINE COMPOUNDS
Injection locked, unstable resonator KrF discharge laser with linewidth of 3 GHz
[UCRL-80495] N78-31421
FLUTTER
Effects of environment, and damping and coupling properties of composite laminates on panel flutter --- airframe materials
[AD-A055753] N78-31175
FLUTTER ANALYSIS
Considerations on wing stores flutter: Asymmetry, flutter suppression
[AGARD-R-668] N78-31126
Asymmetric store flutter
N78-31127
FLUX [RATE]
Three-dimensional inelastic analysis of a small liquid sodium valve
[HEDL-TME-77-91] N78-31435
Search for broad gamma ray lines with the UCR double Compton scatter telescope
N78-31981
FLUX DENSITY
The development and application of new experimental laboratory techniques and equipment for measuring laser energy attenuation in the atmosphere
[AD-A055082] N78-31415
The galactic gamma-ray flux in the 0.06 to 5 MeV range
N78-31979
Gamma ray lines from novae --- stellar mass ejection
N78-31989
HEAO-1 observations of Her X-1 at energies above 13 keV
N78-31994
FLY BY WIRE CONTROL
The terrain following task for the advanced tactical fighter using discrete optimal control
[AD-A055196] N78-31121
A fault-tolerant multiprocessor architecture for aircraft, volume 1 --- autopilot configuration
[NASA-CR-3010] N78-31818
FLYWHEELS
A variable inertia flywheel as an energy storage system
N78-31529
FOAMS
Polymeric foams from cross-linkable poly-n-ary lenebenzimidazoles
[NASA-CASE-ARC-11008-1] N78-31232
Syntactic foam from silver coated microbubbles
[BDX-613-1790-REV] N78-31247
Mechanical properties of 0.2 g/cm-3 polystyrene bead foam
[BDX-613-1725-REV] N78-31250
FOCUSING
A laser scanner for 35mm film
[NASA-CR-150810] N78-31412
FORBIDDEN TRANSITIONS
Forbidden transition selenium atom photodissociation lasers
[UCRL-80490] N78-31422
FORECASTING
IFR aircraft handled forecast by air route traffic control center, fiscal years 1978-1989
[AD-A049305] N78-31075
FORESTS
Automatic classification of reforested Pinus SPP and Eucalyptus SPP in Mogi-Guacu, SP, Brazil, using LANDSAT data
[E78-10182] N78-31481
Nationwide forestry applications program: Ten-Ecosystem Study [TES] site 5 report, Kershaw County, South Carolina, report 4
[E78-10203] N78-31501
Using topographic characteristics to predict total solute concentrations in streams draining small forested watersheds in Western Montana
[PB-280578/6] N78-31520
FORMALISM
Multiperipheral ring dynamics and a definition of the complete twisted Reggeon loop
[LBL-6199] N78-31938
FORTRAN
Two FORTRAN programs for calculating global ionospheric amplitude and phase scintillation
[AD-A055273] N78-31641
Computer science and technology: FORTRAN 4 enhanced character graphics
[PB-279939/3] N78-31772
FOSSIL FUELS
A meso-model of the economy of the United States for comparison of economic and energetic analysis
N78-31562
State-of-the-art reviews and bibliographies on energy. A bibliography with abstracts
[NTIS/PS-78/0586/4] N78-31586
FOURIER SERIES
Outdoor sources of indoor air pollution
[BNL-50762] N78-31595
FOURIER TRANSFORMATION
Exact fermat number transform convolution with comparison to fast Fourier transform techniques
N78-31762
FRACTURE MECHANICS
Mechanical stability of retained austenite in tempered 9Ni steel
[AD-A055240] N78-31217
Crack tip plasticity in dynamic fracture mechanics
[AD-A055159] N78-31470
FRACTURE STRENGTH
Bearing capacity of river ice for vehicles
[AD-A055244] N78-31637
Techniques for dynamic fracture toughness measurements
[PB-280083/7] N78-31656
FRACTURES [MATERIALS]
Feasibility of using fluorescent materials in product assurance applications and for locating adhesive bond fractures
[AD-A055979] N78-31245
FRACTURING
The photomechanical effects as measured by fracture surface energy in KCl
N78-31917
FRANCE
AGRESTE project: Agricultural resources investigations in northern Italy and southern France
[E78-10199] N78-31497
FREE RADICALS
The vinyl reactivity of [eta[5]-vinylcyclopentadienyl] dicarbonyl nitrosylchromium. A novel vinyl organometallic monomer
[AD-A055012] N78-31169
FREEZING
Segregation freezing as the cause of suction force for ice lens formation --- in soils
[AD-A055780] N78-31647
FREQUENCY CONTROL
Tunable magnetoelastic surface wave oscillators
N78-31287
Reflex feed system for dual frequency antenna with frequency cutoff means
[NASA-CASE-NPO-14022-1] N78-31321
Frequency domain stability in single and multidimensional systems
[AD-A055393] N78-31841
FREQUENCY MEASUREMENT
Quantizing the polarization of lead zirconate-titanate
[LBL-7322] N78-31937
FREQUENCY SHIFT
Quartz crystal microbalances: A refined technique for determining changes in mass loading from frequency shifts
[LA-7106-MS] N78-31936
FREQUENCY SHIFT KEYING
Performance analysis of continuous-phase frequency shift keying modulation in atmospheric noise
[AD-A055194] N78-31327
Evaluation of coherent FSK performance in atmospheric radio noise
[AD-A055237] N78-31330
FREQUENCY STANDARDS
Summary of work on cooled ion frequency standard
[AD-A054234] N78-31880
FROST
Segregation freezing as the cause of suction force for ice lens formation --- in soils
[AD-A055780] N78-31647
FROST DAMAGE
Assessment of the damage caused by the frost of 1975 to coffee and wheat crops in the northwest of the state of Parana using LANDSAT images with automatic classification
[E78-10193] N78-31492
FUEL CELLS
High performance metal/air fuel cells. Part 1: General review
[UCID-17558-PT-1] N78-31549
FUEL CONSUMPTION
The influence of overall fuel-air ratio and degree of stratification on the fuel consumption and emissions of a prechamber, stratified-charge engine
N78-31425
The outlook for automotive fuel supplies, alternative vehicle engines, and potential implications for transportation tax structures [1985-2000]
[PB-279679/5] N78-31440
FUEL CORROSION
The effect of fuel-to-air ratio on burner-rig hot corrosion
[NASA-TM-78960] N78-31210
FUEL OILS
Efficiency and investment matching of high quality energy
N78-31560
FUEL TESTS
Burner design criteria for NOx control from low-BTU gas combustion: Volume 2. Elevated fuel temperature
[PB-280199/1] N78-31615
FUEL-AIR RATIO
The effect of fuel-to-air ratio on burner-rig hot corrosion
[NASA-TM-78960] N78-31210
The influence of overall fuel-air ratio and degree of stratification on the fuel consumption and emissions of a prechamber, stratified-charge engine
N78-31425
FUELS
Preliminary findings and views concerning the exemption of kerojet fuels from the mandatory petroleum allocation and price regulations
[DOE/ERA-0002] N78-31958
FUNCTION SPACE
Numerical minimization methods for functionals: Comparison and extensions
[UTIAS-209] N78-31835
FUNCTIONAL ANALYSIS
Neurophysiological assessment of functional states of the brain --- electroencephalographic responses to workloads
N78-31755
Functional analytic treatment of linear transport equations in kinetic theory and neutron transport theory
N78-31888
FUNCTIONALS
Numerical minimization methods for functionals: Comparison and extensions
[UTIAS-209] N78-31835
FUSELAGES
A study of the structural-acoustic response and interior noise levels of fuselage structures
[NASA-CR-157589] N78-31872
FUSION REACTORS
Alloys for the fusion reactor environment: A technical assessment
[DOE/ET-0007] N78-31908

## G

GALACTIC RADIATION
Detection of 511 keV positron annihilation radiation from the galactic center direction --- gamma ray astronomy
N78-31978
The galactic gamma-ray flux in the 0.06 to 5 MeV range
N78-31979
Rice University observations of the galactic center
N78-31982
Galactic center iron line emission
N78-31987
GALACTIC STRUCTURE
Rice University observations of the galactic center
N78-31982
GALAXIES
Gas response to perturbations in disk galaxies
N78-32026
GALLIUM
Ductile superconducting wire through novel metallurgical techniques --- using V3Ga
[LBL-7366] N78-31227
GALLIUM ARSENIDES
Incapsulation and annealing of ion implanted selenium in GaAs
N78-31919
Brillouin scattering of reflected light by the bulk acoustic phonons in GaAs and CdS
N78-31923
Electrical traps in microwave materials
[AD-A055086] N78-31928
Deep level trap spectroscopy of gallium arsenide
[AD-A055198] N78-31933
GALLIUM PHOSPHIDES
Electrical profiling of magnesium implanted gallium phosphide
[AD-A055195] N78-31929
GALVANOMETERS
A laser scanner for 35mm film
[NASA-CR-150810] N78-31412
GAMMA FUNCTION
Kolmogorov-Smirnov test statistics for the gamma distribution with unknown parameters
N78-31850
GAMMA RAY ABSORPTIOMETRY
Least-squares resolution of gamma-ray spectra in environmental samples --- computer program for analyzing sodium iodide gamma spectra
[PB-280237/9] N78-31886
GAMMA RAY ASTRONOMY
Gamma ray spectroscopy in astrophysics --- conferences
[NASA-TM-79619] N78-31971
Mechanisms and sites for astrophysical gamma ray line production
N78-31972
Gamma ray spectroscopy in astrophysics: An observational overview [50 keV-20 MeV]
N78-31973
A hard X-ray and gamma ray observation of the 22 November 1977 solar flare --- experimental design
N78-31974

Detection of 511 keV positron annihilation radiation from the galactic center direction --- gamma ray astronomy
N78-31978
The galactic gamma-ray flux in the 0.06 to 5 MeV range
N78-31979
Low energy gamma ray observations with the MPI-Compton telescope --- balloon-borne detectors
N78-31980
Rice University observations of the galactic center
N78-31982
Observational evidence for extraterrestrial gamma-ray line sources
N78-31983
Gamma ray astronomy and the origin of the light nuclei --- cosmic ray and interstellar gas reactions
N78-31986
Gamma line radiation from supernovae --- nucleosynthesis
N78-31988
Gamma ray lines from novae --- stellar mass ejection
N78-31989
Gamma ray spectroscopy in astrophysics: Future role of scintillation detectors
N78-31999
Capabilities of germanium detectors --- gamma ray spectoscopy
N78-32000
Gamma ray polarimetry --- compton scattering and pair production
[CONTRIB-156] N78-32004
Future directions in experimental gamma ray astronomy --- technology assessment
N78-32005
Cross sections relevant to gamma ray astronomy
N78-32006
The ISEE-C gamma ray burst spectrometer
N78-32009
High resolution spectroscopy from low altitude satellites --- gamma ray astronomy
N78-32010
HEAO C-1 gamma-ray spectrometer --- experimental design
N78-32011
Gamma ray spectroscopy in astrophysics: Solar gamma ray astronomy on solar maximum mission --- experimental design
N78-32012
The gamma ray observatory
N78-32013

**GAMMA RAY TELESCOPES**
Search for broad gamma ray lines with the UCR double Compton scatter telescope
N78-31981

**GAMMA RAYS**
Certain characteristics of the stabilization system of a gamma-ray spectrometer with a light-emitting diode as the source of the reference signal
[UCRL-TRANS-11330] N78-31411
Aerial gamma ray and magnetic survey, Van Horn and Pecos Quadrangles, Texas, volume 1
[GJBX-2-78-VOL-1] N78-31650
The photomechanical effects as measured by fracture surface energy in KCl
N78-31917
Mechanisms and sites for astrophysical gamma ray line production
N78-31972
Gamma ray emission and solar flares
N78-31975
Planetary gamma-ray spectroscopy
N78-31976
Nuclear gamma rays from stellar flares
N78-31977
The galactic gamma-ray flux in the 0.06 to 5 MeV range
N78-31979
Nuclear gamma rays from compact objects --- nuclear interactions around neutron stars and black holes
N78-31984
Gamma-ray lines form neutron stars as probes of fundamental physics
N78-31985
Gamma-ray line emission above 8 MeV
N78-31990
Measurements of 15.11-MeV gamma-ray flux produced in the reactions C-12[p, p']-C-12'[15.11 MeV] and O-16[p, p' alpha]-C-12'[15.11 MeV]
N78-32007
Gamma ray facilities at the University of Maryland cyclotron --- data acquisition and radiation measurement
N78-32008
Solar gamma rays above 8 MeV
[NASA-TM-79623] N78-32031
Gamma-ray evidence for a galactic halo
[NASA-TM-79570] N78-32034

**GARMENTS**
Spacesuit torso closure
[NASA-CASE-ARC-11100-1] N78-31736

**GARNETS**
A survey of properties of latched non-reciprocal ferrite phase shifters with cylindrical rods at 3, 5.5, 9.3, and 16 GHz
[PHL-1977-39] N78-31373

**GAS ANALYSIS**
The analysis of ambient air using atmospheric pressure chemical ionization mass spectrometry
[UTIAS-219] N78-31591
Development of a portable device to collect sulfuric acid aerosol
[PB-280048/0] N78-31603
Organic emissions from automobile interiors --- indoor air pollution
[PB-280374/0] N78-31605
Improved temperature stability of sulfur dioxide samples collected by the federal reference method
[PB-279873/4] N78-31610

**GAS COOLING**
Radiative and gas cooling of falling molten drops
[NASA-TM-78189] N78-31381

**GAS DENSITY**
Gas response to perturbations in disk galaxies
N78-32026

**GAS FLOW**
Gas response to perturbations in disk galaxies
N78-32026

**GAS GENERATORS**
The determination of the Laval nozzle exit conditions at too high counterpressure, especially for a propane oxygen gas generator
[DLR-FB-77-45] N78-31057
Safety analysis LOX-30 liquid oxygen generator
[AD-A054804] N78-31063
Flame stabilization in a ramjet combustion chamber by means of a pilot gas generator
[DLR-FB-77-54] N78-31117

**GAS INJECTION**
An investigation of high pressure gaseous injections into liquid propellants
[AD-A055989] N78-31262

**GAS LASERS**
Compilation of data relevant to rare gas-rare gas and rare gas-monohalide excimer lasers, volume 1
[AD-A053827] N78-31414

**GAS MIXTURES**
Molecular two-dimensional flow of mixtures of light and heavy gases with diffuse and specular reflection -- - preliminary experiments for Spacelab
[DLR-FB-77-51] N78-31060

**GAS PRESSURE**
A pressure limiting propellant actuating system
[NASA-CASE-MSC-18179-1] N78-31162

**GAS TURBINE ENGINES**
A theoretical study of the performance of a number of different axial-flow turbine configurations under conditions of pulsating flow
[ARL-MECH-ENG-REPT-149] N78-31104
Rotor burst protection program: Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1975
[NASA-CR-135304] N78-31105
Advanced optical blade tip clearance measurement system
[NASA-CR-159402] N78-31106

**GAS TURBINES**
Turbine engine rotordynamic evaluation, volume 1
[AD-A055262] N78-31111
High temperature corrosion mechanics --- gas turbines alloys
N78-31231
Mechanisms of exhaust pollutants and plume formation in continuous combustion
[AD-A054844] N78-31594

**GASES**
Nonlinear optical polarizabilities of molecules --- in gases and vapors
N78-31894

**GASOLINE**
Conversion of trash to gasoline
[AD-A055113] N78-31257
Preliminary findings and views concerning the exemption of aviation gasoline from the mandatory petroleum allocation and price regulations
[DOE/ERA-0001] N78-31957

**GATES (OPENINGS)**
Flow-induced gate vibrations: Prevention of self-excitation. Computation of dynamic gate behaviour and the use of models
[PUBL-164] N78-31396

**GEARS**
Rolling element fatigue testing of gear materials
[NASA-CR-135411] N78-31427

**GENERAL AVIATION AIRCRAFT**
Phase-locked tracking loops for LORAN-C
[NASA-CR-157582] N78-31068
General aviation airplane structural crashworthiness user's manual. Volume 1: Program KRASH theory
[AD-A055898] N78-31088
Simulation and flight evaluation of a head-up landing aid for general aviation
[NASA-TP-1276] N78-31101
A research program to reduce interior noise in general aviation airplanes: Noise reduction through a cavity-backed flexible plate
[NASA-CR-157588] N78-31873
A research program to reduce interior noise in general aviation airplanes: Investigation of the characteristics of an acoustic panel test facility
[NASA-CR-157587] N78-31874

**GENETICS**
Translations on USSR science and technology: Biomedical and Behavioral sciences, no. 39
[JPRS-71569] N78-31697
Genetics of microorganisms and medicine
N78-31698
Some pressing problems of genetics
N78-31699

**GEOCHEMISTRY**
Sedimentary geochemistry of carbonate-silicate cyclic sedimentation in deep sea
N78-31477
A study of the geochemistry of pelagic sediments: The interaction of trace metals and magnetic minerals with sedimentary environments
N78-31631

**GEODESY**
Study of geometric distortions of LANDSAT images
[E78-10181] N78-31480

**GEODETIC COORDINATES**
Earth orientation from lunar laser range-differencing
[NASA-CR-157592] N78-32027

**GEODETIC SURVEYS**
Aerial gamma ray and magnetic survey, Van Horn and Pecos Quadrangles, Texas, volume 1
[GJBX-2-78-VOL-1] N78-31650
National Ocean Survey, Fiscal year 1977
[PB-281390/5] N78-31684

**GEOIDS**
The geoid spectrum from altimetry
[NASA-TM-79583] N78-31633

**GEOLOGICAL FAULTS**
Regional investigations of tectonic and igneous geology, Iran, Pakistan, and Turkey
[E78-10197] N78-31495
State-of-the-art for assessing earthquake hazards in the United States. Report 9: Catalogues of strong motion earthquake records. Volume 1: Western United States, 1933-1971
[AD-A055971] N78-31645

**GEOLOGICAL SURVEYS**
Study of magma sources, mantle structure and the differentiation of the earth from variations of Nd-143/Nd-144 in igneous rocks
N78-31630
Geodynamic international-11
[PB-280747/7] N78-31660

**GEOLOGY**
Geological mapping of regional drainage network in Brazil using LANDSAT images
[E78-10185] N78-31484
Collected summaries of works dealing with the application of LANDSAT imagery in the survey of mineral resources
[E78-10191] N78-31490
Geologic application of thermal inertia imaging using HCMM data
[E78-10195] N78-31493
Regional investigations of tectonic and igneous geology, Iran, Pakistan, and Turkey
[E78-10197] N78-31495
A summary of the users perspective of LANDSAT-D and reference document of LANDSAT users
[E78-10208] N78-31506

**GEOMAGNETISM**
Study of attitude control systems using the earth's magnetic field at synchronous altitudes
[ESS/SS-834] N78-31154

**GEOMORPHOLOGY**
Geological mapping of regional drainage network in Brazil using LANDSAT images
[E78-10185] N78-31484
Problems associated with maintenance of channel capacity below federal reservoirs in Kansas
[PB-280560/4] N78-31522

**GEOPHYSICS**
An introduction to turbulence in geophysics and air-sea interactions
[AGARD-AG-232] N78-31661

**GEOSYNCHRONOUS ORBITS**
Study of attitude control systems using the earth's magnetic field at synchronous altitudes
[ESS/SS-834] N78-31154

**GEOTHERMAL ENERGY CONVERSION**
Preliminary design manual for a geothermal demonstration plant at Herber, California
[EPRI-ER-670] N78-31575
Application of direct contact heat exchangers to geothermal power production cycles
[IDO-1549-8] N78-31578

**GEOTHERMAL RESOURCES**
Hot dry rock, an alternate geothermal energy resource: A challenge for instrumentation
[LA-UR-78-707] N78-31553

Geothermal exploration techniques: A case study
[EPRI-ER-680] N78-31577
State-of-the-art reviews and bibliographies on energy. A bibliography with abstracts
[NTIS/PS-78/0586/4] N78-31586
Telluric and D. C. resistivity techniques applied to the geophysical investigation of basin and range geothermal systems
N78-31627

GERMANIUM
Nucleation phenomena in the formation electron-hole drops in Ge
N78-31910
Electron tunneling into the A15 superconductors: Nb3Sn, V3Si, and Nb3Ge
N78-31924
Capabilities of germanium detectors --- gamma ray spectoscopy
N78-32000
Background of a shielded Ge[Li] spectrometer at balloon altitudes
N78-32001
Radiation damage of germanium detectors
N78-32002

GLASS
MCP glass analysis studies
[AD-A055251] N78-31242

GLIDE PATHS
Capture effect array glide slope guidance study
[AD-A055678] N78-31073

GLIDERS
Trajectory optimization for some sailplane performance problems
N78-31083

GLOW DISCHARGES
Boron trifluoride coatings for thermoplastic materials and method of applying same in glow discharge
[NASA-CASE-ARC-11057-1] N78-31233

GOLD ALLOYS
Electron scattering rate anisotropy and conduction electron-4f moment interactions Au[rare earth] dilute alloys
N78-31920

GRAIN BOUNDARIES
Structure of gain boundaries in silicon nitride based alloys --- electron microscopy of MgO, Y2O3, and magnesium-sialon
[LBL-6985] N78-31177
Direct observation of grain boundary diffusion by scanning Auger microscopy --- scanning electron microscopy of metal films
[COO-2679-14] N78-31935

GRAMMARS
On the complexity of grammar and language problems
N78-31782

GRAPHITE-EPOXY COMPOSITE MATERIALS
Design and fabrication of a ring-stiffened graphite-epoxy corrugated cylindrical shell
[NASA-CR-3026] N78-31465

GRASSLANDS
INPE's crop survey program using combined LANDSAT and aircraft data
[E78-10184] N78-31483
Use of LANDSAT data to monitor pasture project in Amazonia
[E78-10192] N78-31491

GRAVIMETRY
Gravitational spectra from direct measurements
[NASA-TM-79603] N78-31634

GRAVITATIONAL EFFECTS
Draining characteristics of hemispherically bottomed cylinders in a low-gravity environment
[NASA-TP-1297] N78-31384

GRAVITATIONAL FIELDS
Gravitational spectra from direct measurements
[NASA-TM-79603] N78-31634
Gas response to perturbations in disk galaxies
N78-32026

GREAT SMOKY MOUNTAINS [NC-TN]
Remeasurement of permanent vegetation plots in the Great Smoky Mountains National Park, Tennessee, USA, and the implications of climatic change on vegetation
[ORNL-TM-6083] N78-31515

GROUND BASED CONTROL
Capture effect array glide slope guidance study
[AD-A055678] N78-31073

GROUND EFFECT MACHINES
Vibration aspects of ride quality modeling for the DOT PTACV: Theory and experiment
[PB-279846/0] N78-31744
TLV [Tracked Levitated Vehicle] status report
[PB-279845/2] N78-31961

GROUND STATIONS
IFR aircraft handled forecast by air route traffic control center, fiscal years 1978-1989
[AD-A049305] N78-31075
INPE LANDSAT system
[E78-10180] N78-31479
The capability of a network of seismological stations to detect events and to obtain identification parameters
[FOA-C-20231-T1] N78-31654
Baseline National Airspace Data Interchange Network [NADIN] data base
[AD-A056112] N78-31949

GROUND TRUTH
Automatic classification of reforested Pinus SPP and Eucalyptus SPP in Mogi-Guacu, SP, Brazil, using LANDSAT data
[E78-10182] N78-31481
Procedures for gathering ground truth information for a supervised approach to a computer implemented land cover classification of LANDSAT acquired multispectral scanner data --- Mississippi
[E78-10198] N78-31496
Nationwide forestry applications program: Ten-Ecosystem Study [TES] site 5 report, Kershaw County, South Carolina, report 4
[E78-10203] N78-31501

GROUND WATER
Heat capacity mapping mission
[E78-10196] N78-31494
Application of heat-flow temperature model for remotely assessing near surface soil moisture by thermography
[PB-279616/7] N78-31518

GROUND-AIR-GROUND COMMUNICATIONS
Link analysis program LINKAN. Volume 1: Theoretical and programmer's manual --- satellite communication links
[ESA-CR[P]-1083-VOL-1] N78-31350
Link analysis program LINKAN. Volume 2: User's manual --- satellite communication links
[ESA-CR[P]-1083-VOL-2] N78-31351

GUN PROPELLANTS
Nitramine propellants --- gun propellant burning rate
[NASA-CASE-NPO-14103-1] N78-31255

GUNS [ORDNANCE]
Hazard assessment of aircraft gun compartments
[AD-A055026] N78-31064
An investigation of high pressure gaseous injections into liquid propellants
[AD-A055989] N78-31262

GUST LOADS
Gust front analytical study
[AD-A056151] N78-31669

## H

HALIDES
Compilation of data relevant to rare gas-rare gas and rare gas-monohalide excimer lasers, volume 1
[AD-A053827] N78-31414

HALL EFFECT
Anomalous hall effect and oscillatory photoconductivity in p-type mercury cadmium telluride
N78-31926

HARMONIC GENERATIONS
Nonlinear optical polarizabilities of molecules --- in gases and vapors
N78-31894
Optical difference frequency generation of far infrared radiation
N78-31895

HEAD-UP DISPLAYS
Simulation and flight evaluation of a head-up landing aid for general aviation
[NASA-TP-1276] N78-31101

HEALTH PHYSICS
A literature review: Problem definition studies on selected toxic chemicals. Volume 6: Occupational health and safety and environmental aspects of urea-formaldehyde resins
[AD-A054991] N78-31716
Nitrogen oxides: Current status of knowledge
[EPRI-EA-668] N78-31723

HEAO
HEAO-1 observations of Her X-1 at energies above 13 keV
N78-31994

HEAT CAPACITY MAPPING MISSION
Geologic application of thermal inertia imaging using HCMM data
[E78-10195] N78-31493
Heat capacity mapping mission
[E78-10196] N78-31494

HEAT EXCHANGERS
An experimental investigation of enhanced heat transfer on horizontal condenser tubes
[AD-A055430] N78-31392
Preliminary evaluation of tubular ceramic heat exchanger materials
[TID-28279] N78-31393
Application of direct contact heat exchangers to geothermal power production cycles
[IDO-1549-8] N78-31578

HEAT MEASUREMENT
Absorptance of IR laser radiation at a metallic interface at various angles of incidence and polarizations
[AD-A055256] N78-31418
Thermal and kinetic analysis of the pyrolysis of coals
[EPRI-AF-528] N78-31552

HEAT PIPES
Design and development of a gas controlled heat pipe radiator for communication spacecraft application. Life test report
[ESA-CR[P]-1082] N78-31399

HEAT RESISTANT ALLOYS
Longitudinal shear behavior of several oxide dispersion strengthened alloys
[NASA-TM-78973] N78-31211

HEAT SINKS
Thermal performance measurements on ultimate heat sinks: Cooling ponds
[NUREG/CR-0008] N78-31394

HEAT STORAGE
Transient behavior of solid sensible heat thermal energy storage units
N78-31528
Form-stable crystalline polymer pellets for thermal energy storage, phase 1
[ORO-5159-10] N78-31582

HEAT TRANSFER
Analysis of metal temperature and coolant flow with a thermal-barrier coating on a full-coverage-film-cooled turbine vane
[NASA-TP-1310] N78-31109
Heat transfer modeling and analytical quenching of a powder metallurgy turbine disk during heat treatment
[AD-A054022] N78-31110
Filling of orbital fluid management systems
[NASA-CR-159404] N78-31380
Study of heat transfer through refractory lined gasifier vessel walls
[FE-2210-18] N78-31385
An experimental investigation of enhanced heat transfer on horizontal condenser tubes
[AD-A055430] N78-31392

HEAT TRANSFER COEFFICIENTS
Hot gas side heat transfer coefficients in high energy rocket engines with thrust variation
[DLR-FB-77-42] N78-31165

HEAT TREATMENT
Heat transfer modeling and analytical quenching of a powder metallurgy turbine disk during heat treatment
[AD-A054022] N78-31110
Rolling element fatigue testing of gear materials
[NASA-CR-135411] N78-31427

HEATING EQUIPMENT
Double-exposure collector system
[TID-28291] N78-31576

HEAVY IONS
Pionic instabilities in high-energy heavy ion collisions
[LBL-6525] N78-31882

HELICOPTER ENGINES
Engine/airframe/drive train dynamic interface documentation
[AD-A055766] N78-31114

HELICOPTER PERFORMANCE
Evaluation of a circulation control tail boom for yaw control --- OH-6 helicopter
[AD-A055116] N78-31119
Applications of a charge coupled device sensor for Nap-of-the-Earth helicopter operations
N78-31305

HELICOPTER PROPELLER DRIVE
An improved computational procedure for determining helicopter rotor blade natural modes
[NASA-TM-78670] N78-31792

HELICOPTERS
Helicopter transmission vibration and noise reduction program. Volume 1: Technical report
[AD-A055104] N78-31089

HERCULES NOVA
Cyclotron lines form Her X-1
N78-31991
Confidence about line features in Her X-1 spectrum
N78-31992
Upper limits on the cyclotron lines from Her X-1 as observed with OSO-8
N78-31993
HEAO-1 observations of Her X-1 at energies above 13 keV
N78-31994
The transfer of cyclotron lines through the magnetospheric shell of Hercules X-1
N78-31997

HETERODYNING
A theoretical and experimental study of Josephson frequency mixers for heterodyne reception in the submillimetre wavelength range
[ESA-CR[P]-1063] N78-31348

HIGH ALTITUDE
The use of ram rockets for high altitude missiles
[DLR-FB-77-47] N78-31153
High altitude perspective --- cost-reimbursable services using NASA U-2 aircraft
[NASA-SP-427] N78-31508

HIGH ALTITUDE ENVIRONMENTS
The effect of high altitude on pyridine nucleotides and adenosine phosphates in the liver of the rat
N78-31689

**HIGH ASPECT RATIO**
Control-surface hinge-moment calculations for a high-aspectratio supercritical wing
[NASA-TM-78664] N78-31043

**HIGH ENERGY INTERACTIONS**
Compilation of data relevant to rare gas-rare gas and rare gas-monohalide excimer lasers, volume 1
[AD-A053827] N78-31414
Gamma-ray line emission above 8 MeV
N78-31990

**HIGH ENERGY PROPELLANTS**
Energy losses in high energy rocket engines with thrust variation
[DLR-FB-77-41] N78-31166

**HIGH FREQUENCIES**
High-frequency techniques and over-the-horizon radar in coastal research
[AD-A054846] N78-31332
On the relative location of the plasmapause and the HF backscatter curtains
[REPT-23] N78-31636

**HIGH PRESSURE**
Structure and dynamics of organic materials under high pressure
N78-31167
An investigation of high pressure gaseous injections into liquid propellants
[AD-A055989] N78-31262
Work Capability and physiological effects Predictive studies. 4: in HE-02 excursions to pressures of 400-800-1200- and 1600 feet of sea water
[NASA-CR-157571] N78-31714
Piezo-optic properties of liquids under high pressure --- interferometry of refractive index variations
N78-31898

**HIGH RESOLUTION**
High resolution spectroscopy from low altitude satellites --- gamma ray astronomy
N78-32010

**HIGH STRENGTH STEELS**
Solidification of electroslag remelted low alloy steel ingots
[AD-A055576] N78-31221

**HIGH TEMPERATURE**
High temperature corrosion mechanics --- gas turbines alloys
N78-31231
High-temperature shock initiation of explosives
[LA-7158] N78-31267

**HIGH TEMPERATURE GASES**
Hot gas side heat transfer coefficients in high energy rocket engines with thrust varintion
[DLR-FB-77-42] N78-31165
Burner design criteria for NOx control from low-BTU gas combustion: Volume 2. Elevated fuel temperature
[PB-280199/1] N78-31615

**HIGH TEMPERATURE RESEARCH**
Review of the AGARD S and M panel evaluation program of the NASA-Lewis SRP approach to high-temperature LCF life prediction
[NASA-TM-78879] N78-31209
Cobalt as an analogue for iron in high temperature experiments on basaltic compositions
N78-31629

**HIGH VOLTAGES**
Insulation techniques in high voltage high power converters
[ESA-CR[P]-1073] N78-31374
REB focusing in a high-voltage diode --- pulsed electron accelerators
[SAND-78-6005] N78-31883

**HIGHWAYS**
Optimization and testing of highway materials to mitigate ice adhesion
[PB-280927/5] N78-31276

**HILBERT SPACE**
Some path properties of p-TH order and symmetric stable processes
[AD-A055844] N78-31857
Basic optimal estimation and control problems in Hilbert space
[AD-A055614] N78-31864

**HISTORIES**
A historic and current energy analysis of Florida
N78-31568

**HOLES (ELECTRON DEFICIENCIES)**
Nucleation phenomena in the formation electron-hole drops in Ge
N78-31910

**HOLOGRAPHY**
Review of photosensitive materials for holographic recordings
[AD-A055013] N78-31407

**HOMOTOPY THEORY**
Resolution space, networks, and non-self-adjoint spectral theory II
[AD-A055613] N78-31865

**HORN ANTENNAS**
Reflex feed system for dual frequency antenna with frequency cutoff means
[NASA-CASE-NPO-14022-1] N78-31321

**HOT-WIRE ANEMOMETERS**
On temperature and yaw dependence of hot-wires
[AD-A055937] N78-31408

**HUGONIOT EQUATION OF STATE**
Equation of state of vanadium
[UCID-17696] N78-31226

**HUMAN BODY**
Air quality criteria for lead
[PB-280411/0] N78-31730
Cold weather stress on humans. A bibliography with abstracts
[NTIS/PS-78/0540/1] N78-31732

**HUMAN FACTORS ENGINEERING**
Evaluation of AAFE apparatus to measure residual and transient convection in zero-gravity
[NASA-TM-78191] N78-31382
Development and fabrication of a prototype Fibrous Aerosol Monitor [FAM]
[PB-280126/4] N78-31613
Contrast sensitivity of the human visual system at one luminance level while adapted to a stimulus at another luminance level
[AD-A055238] N78-31717
Spacesuit mobility joints
[NASA-CASE-ARC-11058-1] N78-31735
Spacesuit torso closure
[NASA-CASE-ARC-11100-1] N78-31736
Methods to assess work load
[AGARD-CP-216] N78-31745
The human operator simulator: Workload estimation using a simulated secondary task
N78-31756
Operator workload assessment model: An evaluation of a VF/VA-V/STOL system
N78-31757

**HUMAN PERFORMANCE**
Determination of stress and strain of air traffic control officers --- physiological response measurements
N78-31751
Physiological measures of workloads: Correlations between physiological parameters and operational performance
N78-31753
Estimation of the operating characteristics of the two-parameter beta method
[AD-A055611] N78-31860

**HUMAN TOLERANCES**
The vibrating environment in transport vehicles: A critical bibliographical study --- human tolerance to vibratory loads
[RAE-LIB-TRANS-1917] N78-31738

**HUMAN WASTES**
Effects of diversion and alum application on two eutrophic lakes
[PB-280983/8] N78-31624
Research needs relating to on-site Treatment of Domestic Wastes: Summary of Workshop
[PB-280989/5] N78-31966

**HYBRID CIRCUITS**
A hybrid SAW/CCD signal processor
N78-31290
Hybrid microcircuit failure rate prediction
[AD-A055756] N78-31367
Study of hybrid power structures
[ESA-CR[P]-1075] N78-31375
Evaluation and qualification of thick film hybrid microcircuits --- for space application
[ESA-SPEC-QRC-06-ISSUE-2-REV-1] N78-31376

**HYDRAULIC FLUIDS**
A technique for evaluating fuel and hydraulic fluid ballistic vulnerability
[AD-A055058] N78-31188

**HYDROCARBON FUELS**
Assessment of low- and intermediate-Btu gasification of coal
[FE-1216-4] N78-31554

**HYDROCARBONS**
Procedures for quantifying relationships between photochemical oxidants and precursors: Supporting documentation
[PB-280058/9] N78-31614

**HYDRODYNAMICS**
Nonlinear treatment of self-diffusion in liquids --- incoherent scattering law
N78-31185
Investigation on the influence of a hydrodynamic precursor stage on the heat transfer at a flat channel wall
[ILR-22] N78-31397
Rotating arm experiments for the stable semi-submerged platform [SSP] manuevering predictions
[AD-A055721] N78-31434
Surface hydrodynamical models through synoptic interpretation of LANDSAT MSS images in lagoonal and coastal waters
[E78-10188] N78-31487

**HYDROFOILS**
Initial investigation of stationary hydrofoil cavitation and cavitation noise scaling
[AD-A055260] N78-31271

**HYDROGEN CHLORIDES**
Vibrational relaxation and energy transfer of matrix isolated HCl and DCl
[LBL-7344] N78-31885

**HYDROGEN EMBRITTLEMENT**
Hydrogen attack of steel
[COO-2872-2] N78-31223

**HYDROGEN FUELS**
Hydrogen technology, foreign
[AD-A055024] N78-31261

**HYDROGEN PRODUCTION**
Production method for hydrogen by thermomechanical decomposition of water
[LA-TR-77-52] N78-31265

**HYDROGRAPHY**
High-frequency techniques and over-the-horizon radar in coastal research
[AD-A054846] N78-31332

**HYDROLOGY**
Retransmission of hydrometric data in Canada
[E78-10204] N78-31502

**HYDROMECHANICS**
Backup control for a variable cycle engine --- fighter aircraft
[AD-A055658] N78-31116

**HYPERSONIC AIRCRAFT**
Aerodynamic characteristics of a hypersonic research airplane concept having a 70 deg swept double-delta wing at Mach number 0.2
[NASA-TP-1252] N78-31045

**HYPOXIA**
The effect of high altitude on pyridine nucleotides and adenosine phosphates in the liver of the rat
N78-31689
Physiological measures of workloads: Correlations between physiological parameters and operational performance
N78-31753


## I


**IBM 360 COMPUTER**
RSX-11D/DX11-B interface user's guide
[NASA-CR-150809] N78-31795

**IBM 370 COMPUTER**
RSX-11D/DX11-B interface user's guide
[NASA-CR-150809] N78-31795

**ICE**
Bearing capacity of river ice for vehicles
[AD-A055244] N78-31637
A comparison between derived internal dielectric properties and radio-echo sounding records of the ice sheet at Cape Folger, Antarctica
[AD-A055245] N78-31638

**ICE FORMATION**
Modified helicopter icing spray system evaluation
[AD-A055039] N78-31091
Segregation freezing as the cause of suction force for ice lens formation --- in soils
[AD-A055780] N78-31647

**ICE PREVENTION**
Optimization and testing of highway materials to mitigate ice adhesion
[PB-280927/5] N78-31276

**IDENTIFYING**
Review of methods for description of random transmission channels applications to identification and optimisation of detection and transmission processes
[CEPHAG-35/77] N78-31347

**IGNEOUS ROCKS**
Regional investigations of tectonic and igneous geology, Iran, Pakistan, and Turkey
[E78-10197] N78-31495
Study of magma sources, mantle structure and the differentiation of the earth from variations of Nd-143/Nd-144 in igneous rocks
N78-31630

**ILLINOIS**
Catalog of water resources research in Illinois
[PB-280561/2] N78-31523
Cost of solid waste management in northeast Illinois
[PB-280562/0] N78-31964

**IMAGE CONTRAST**
Study of geometric distortions of LANDSAT images
[E78-10181] N78-31480
Contrast sensitivity of the human visual system at one luminance level while adapted to a stimulus at another luminance level
[AD-A055238] N78-31717

**IMAGE ENHANCEMENT**
Digital enhancement of computerized axial tomograms
[NASA-TM-78974] N78-31690

**IMAGE PROCESSING**
IRCCD imaging sensors: A review of device options
N78-31302
CCPD: The optimum solid-state line scanner
N78-31303
Reading and acoustic processing of optical images
N78-31304
Applications of a charge coupled device sensor for Nap-of-the-Earth helicopter operations
N78-31305
A CCD digital image store
N78-31306
A CCD memory chip for radar image processing
N78-31307

Charge Injection Device (CID) Hadamard plane processor for image bandwidth compression
N78-31309
A high performance CCD Linear Imaging Array
N78-31310
Radar image modeling and processing for real-time RF simulation
[AD-A055060] N78-31333
Array scanning techniques
[AD-A055176] N78-31359
Adaptive Kalman type estimation applied to image processing
[AD-A055827] N78-31365
ORIS: The Oak Ridge Imaging System program listings
[ORNL-TM-5875-V3] N78-31722
Syntactic algorithms for image segmentation and a special computer architecture for image processing
N78-31785
Some new results on image processing and recognition
[AD-A055862] N78-31807
Analysis of a cooperative stereo algorithm
[AD-A055099] N78-31899
Representing visual information
[AD-A055045] N78-31951

IMAGERY
Impact of charge coupled devices and Surface Acoustic Wave Devices on Signal Processing and Imagery in Advanced Systems --- Conferences
[AGARD-CP-230] N78-31279
State-of-the-art of CCD and SAW technologies
N78-31280
Diagnostic improvements in medical ultrasonic imaging systems
N78-31710

IMAGES
Reading and acoustic processing of optical images
N78-31304

IMAGING TECHNIQUES
Study of geometric distortions of LANDSAT images
[E78-10181] N78-31480
Design and construction of the Donner 280-crystal positron ring for dynamic transverse section emission imaging
[LBL-5679] N78-31721

IMPACT TESTS
System for vacuum pouring of epoxy tensile and impact specimens with a study of the behavior of these specimens at 77 K and 293 K
[ORNL-TM-5493] N78-31178
Impact thresholds for the initiation of metal sparking
[AD-A054738] N78-31189
Impact of rock debris on a simply supported beam
[AD-A055077] N78-31467

IMPINGEMENT
Ground impingement of a fan jet exhaust plume
[AD-A054832] N78-31112

IMPURITIES
Electromagnetic penetration depth in superconducting alloys containing magnetic impurities
[COO-1198-1193] N78-31868
A study of the diffusion of tracer impurities in the Versator 1 Tokamak plasma by spectral emissions in the vacuum ultraviolet range
[AD-A054756] N78-31906

IN-FLIGHT MONITORING
Is man the weakest link? --- real time activity recording of aircrew workloads
N78-31746

INCOHERENT SCATTERING
Nonlinear treatment of self-diffusion in liquids --- incoherent scattering law
N78-31185

INCOMPRESSIBLE FLOW
Large eddy simulation of incompressible turbulent channel flow
[NASA-CR-157575] N78-31383
A simple finite-difference technique for the computation of threedimensional incompressible laminar boundary layers. Part 2: Description of the program
[NLR-TR-76086-U-PT-2] N78-31398

INDEPENDENT VARIABLES
Kolmogorov-Smirnov test statistics for the gamma distribution with unknown parameters
N78-31850

INDEXES (DOCUMENTATION)
Aeronautical engineering: A continuing bibliography with indexes, supplement 98
[NASA-SP-7037[98]] N78-31041
Current knowledge on numerical data indexing and possible future developments
[PB-279924/5] N78-31953

INDIUM
Studies of indium-doped silicon
[AD-A054479] N78-31927

INDIUM ALLOYS
Electromagnetic penetration depth in superconducting alloys containing magnetic impurities
[COO-1198-1193] N78-31868

INDIUM ANTIMONIDES
Piezoresistivity and its magnetic field dependence in N-type indium-antimonide
N78-31914

INDUSTRIAL AREAS
LANDSAT [MSS]: Image demographic estimations
[E78-10183] N78-31482

INDUSTRIAL PLANTS
Applications of thermal energy storage to process heat storage and recovery in the paper and pulp industry
[NASA-CR-159398] N78-31537
The role of technological and lay-out factors, as well as climate, in formation of the air basin in the region of chemical plants
N78-31700
On the question of rapidly setting hygienic standards for industrial substances with irritant action
N78-31701

INDUSTRIAL SAFETY
Development and fabrication of a prototype Fibrous Aerosol Monitor [FAM]
[PB-280126/4] N78-31613
Translations on USSR science and technology: Biomedical and Behavioral sciences, no. 39
[JPRS-71569] N78-31697
On the question of rapidly setting hygienic standards for industrial substances with irritant action
N78-31701

INDUSTRIAL WASTES
Identification of components of energy-related wastes and effluents
[PB-280203/1] N78-31606
Water quality management guidance for mine-related pollution sources [new, current and abandoned]
[PB-280625/5] N78-31616
Proposed issuance of a new source National Pollutant Discharge Elimination System Permit No. IA-0060909 to Iowa Southern utilities company, Ottumwa generating station for discharge of wastewaters to the Des Moines River near Ottumwa, Iowa
[PB-280369/0] N78-31617
Pilot investigation of secondary sludge dewatering alternatives
[PB-280982/0] N78-31967

INELASTIC SCATTERING
The constant volume hypothesis for the inelastic deformation of metals in the small strain range
[AD-A054253] N78-31215

INERTIAL GUIDANCE
Optimization and estimation in nonlinear systems with application to inertial guidance
N78-31139

INFLATABLE STRUCTURES
Inflatable liferaft tests in the Pacific Ocean of the Columbia River Bar
[AD-A055323] N78-31065

INFORMATION MANAGEMENT
Software acquisition management guidebook: Cost estimation and measurement
[AD-A055574] N78-31809
Large scale information systems, volume 1
[AD-A054942] N78-31950

INFORMATION RETRIEVAL
Computer identification of infrared spectra by correlation-based file searching
[AD-A055277] N78-31770
Preliminary design of an accident Information Retrieval System [AIRS]
[AD-A055590] N78-31952

INFORMATION SYSTEMS
Dedicated computer control of chemical instrumentation
[AD-A055268] N78-31190
Remote sensing applications to Missouri environmental resources information system
[E78-10209] N78-31507
Large scale information systems, volume 1
[AD-A054942] N78-31950

INFORMATION THEORY
A dual optimization framework for some problems of information theory and statistics
[AD-A055155] N78-31802

INFRARED DETECTORS
Computer software for analysis of infrared targets and clutter
[AD-A054235] N78-31796

INFRARED IMAGERY
Modelization of metal insulating semiconductor devices on CgHgTe application to a charge transfer device for infrared imagery
N78-31301

INFRARED LASERS
Absorptance of IR laser radiation at a metallic interface at various angles of incidence and polarizations
[AD-A055256] N78-31418
Development and evaluation of an ultrasonic imaging system
[PB-279834/6] N78-31729
Optical difference frequency generation of far infrared radiation
N78-31895

INFRARED RADIATION
Hazard analysis of broad-band optical sources
[AD-A054802] N78-31900

INFRARED SPECTRA
Design of a flow facility for quantitative spectroscopic studies of high temperature species --- infrared absorption coefficients of boron compounds in the vapor phase
[AD-A054842] N78-31187
Computer identification of infrared spectra by correlation-based file searching
[AD-A055277] N78-31770
Computer software for analysis of infrared targets and clutter
[AD-A054235] N78-31796

INFRARED SPECTROMETERS
The skylab S191 spectrometer experiment: Analysis of data and their applications to the earth sciences
[NASA-TM-58208] N78-31509

INFRARED SPECTROSCOPY
Use of a semiconductor laser in infrared spectroscopy --- air pollution monitoring
[IS-T-786] N78-31196
Infrared studies of the solid state polymerization of diacetylene monomers
[AD-A055988] N78-31244

INITIATION
High-temperature shock initiation of explosives
[LA-7158] N78-31267

INJECTION LASERS
Injection locked, unstable resonator KrF discharge laser with linewidth of 3 GHz
[UCRL-80495] N78-31421

INJURIES
Electrical enhancement of healing in combat injuries to hard and soft tissues
[AD-A055531] N78-31718

INLET FLOW
Investigation on the influence of a hydrodynamic precursor stage on the heat transfer at a flat channel wall
[ILR-22] N78-31397
Effect of inlet temperature on the performance of a catalytic reactor --- air pollution control
[NASA-TM-78977] N78-31534

INORGANIC COATINGS
Boron trifluoride coatings for thermoplastic materials and method of applying same in glow discharge
[NASA-CASE-ARC-11057-1] N78-31233

INSECTICIDES
Toxicological evaluation of Pyrethrins Fogging Concentrate [trade name] study No. 51-1309-78
[AD-A055088] N78-31715

INSTALLATION MANUALS
Design and installation package for the Sunmat Flat Plate solar collector
[NASA-CR-150741] N78-31536

INSTRUCTION SETS (COMPUTERS)
Analysis and performance of computer instruction sets
N78-31780

INSTRUMENT COMPENSATION
Studies in fluorescence spectroscopy
N78-31182
On temperature and yaw dependence of hot-wires
[AD-A055937] N78-31408

INSTRUMENT FLIGHT RULES
IFR aircraft handled forecast by air route traffic control center, fiscal years 1978-1989
[AD-A049305] N78-31075

INSTRUMENT LANDING SYSTEMS
Capture effect array glide slope guidance study
[AD-A055678] N78-31073

INSTRUMENTS
Dedicated computer control of chemical instrumentation
[AD-A055268] N78-31190

INSULATORS
Contamination flashover mechanisms of dc transmission line insulators
[HCP/T2068-1] N78-31372

INTEGRAL EQUATIONS
A nonlinear uniaxial integral constitutive equation incorporative rate effects, creep, and relaxation
[AD-A054252] N78-31216
Integral formulation of Einstein's equations and Mach's principle
N78-31866

INTEGRATED CIRCUITS
IC fabrication using electron-beam technology
[AD-A055610] N78-31368
Integrated circuit reliability, volume 3. A bibliography with abstracts
[NTIS/PS-78/0579/9] N78-31377

INTEGRATORS
A novel signal integrator using CCDs
N78-31316

INTERFACES
RSX-11D/DX11-B interface user's guide
[NASA-CR-150809] N78-31795

INTERFEROMETRY
Piezo-optic properties of liquids under high pressure --- interferometry of refractive index variations
N78-31898

INTERNAL COMBUSTION ENGINES
Rotary expander engine development program
[AD-A055662] N78-31432

**INTERNAL PRESSURE**
Correlation of combustor acoustic power levels inferred from internal fluctuating pressure measurements
[NASA-TM-78986] N78-31871
**INTERNATIONAL COOPERATION**
International space activities
[GPO-30-920] N78-31137
International scientific activities at selected institutions, 1975-1976 and 1976-1977
[PB-280151/2] N78-31943
**INTERNATIONAL SUN AND EARTH EXPLORERS**
The ISEE-C gamma ray burst spectrometer
N78-32009
**INTERNATIONAL SUN EARTH EXPLORER 2**
Evaluation of Amper journal bearings for ISEE-B boom hinge
[ESA-ESTL-29] N78-31439
**INTERRUPTION**
Repetitive series interrupter 2
[AD-A055253] N78-31363
**INTERSTELLAR GAS**
Gamma ray astronomy and the origin of the light nuclei --- cosmic ray and interstellar gas reactions
N78-31986
**INTERSTELLAR MAGNETIC FIELDS**
Gamma-ray evidence for a galactic halo
[NASA-TM-79570] N78-32034
**INVARIANCE**
Investigation of optimal linear shift-invariant two-dimensional digital filters
[AD-A055449] N78-31369
**INVENTIONS**
Gas path seal
[NASA-CASE-LEW-12131-2] N78-31103
**INVERSIONS**
On the multiplicity of solutions of the inverse problem for a vibrating beam
[NASA-CR-157572] N78-31466
**INVISCID FLOW**
Wall boundary layers in cascades
[ARC-CP-1388] N78-31058
**IODINE**
Disposal of radioactive iodine in space
[NASA-TP-1313] N78-31740
**ION CYCLOTRON RADIATION**
Alfven/ion cyclotron waves and the ion cyclotron instability in the earth's magnetosphere
N78-31628
**ION DENSITY (CONCENTRATION)**
Ion cloud modeling
[AD-A055969] N78-31648
**ION EMISSION**
Thermodynamic interpretation of secondary ion and photon emission during sputtering of silicon
N78-31912
**ION EXCHANGING**
Unusual magnetic properties in two copper (II) chelates of Schiff bases derived from alpha-amino acids: A dimeric interaction in a structural linear chain
[AD-A055101] N78-31168
**ION IMPLANTATION**
Incapsulation and annealing of ion implanted selenium in GaAs
N78-31919
Electrical profiling of magnesium implanted gallium phosphide
[AD-A055195] N78-31929
**ION TRAPS (INSTRUMENTATION)**
Summary of work on cooled ion frequency standard
[AD-A054234] N78-31880
**IONIC COLLISIONS**
Pionic instabilities in high-energy heavy ion collisions
[LBL-6525] N78-31882
**IONIZATION**
The laser lightning rod system: A feasibility study
[AD-A055255] N78-31417
**IONIZED GASES**
The analysis of ambient air using atmospheric pressure chemical ionization mass spectrometry
[UTIAS-219] N78-31591
**IONIZING RADIATION**
Dependence of the reaction of the human nervous system on the distribution of absorbed doses of ionizing radiation
N78-31704
Late biological effects of ionizing radiation as influenced by dose, dose rate, age at exposure, and genetic sensitivity to neoplastic transformation
[LA-UR-78-681] N78-31724
**IONOSPHERIC DISTURBANCES**
UHF scintillation characteristics as observed from Keflavik, Iceland
[AD-A055760] N78-31344
**IONOSPHERICS**
Two FORTRAN programs for calculating global ionospheric amplitude and phase scintillation
[AD-A055273] N78-31641
**IONS**
Reaction rate data, number 61
[AD-A055983] N78-31644
**IRAN**
Regional investigations of tectonic and igneous geology, Iran, Pakistan, and Turkey
[E78-10197] N78-31495
**IRON**
Alternating tension-compression fatigue strength and property changes of steel after cold deformation at different deformation rates
[RAE-LIB-TRANS-1967] N78-31207
Effects of thermomechanical processing on strength and toughness of iron - 12-percent-nickel - reactive metal alloys at -196 C
[NASA-TP-1308] N78-31213
Galactic center iron line emission
N78-31987
**IRON ALLOYS**
Microstructure and magnetic properties of Fe-Cr-Co-V alloys
[LBL-6931] N78-31225
**IRON COMPOUNDS**
Cobalt as an analogue for iron in high temperature experiments on basaltic compositions
N78-31629
Domain orientation in single crystal TbFe[2] and Tb[.27]Dy[.73]Fe[2]
[AD-A055025] N78-31931
**IRON OXIDES**
Design and cost study of a nickel-iron oxide battery for electric vehicles. Volume 2: Public report
[ANL-K-3723-1] N78-31551
**ISOTHERMAL PROCESSES**
Pressure distribution in an open cavity at linear increasing external pressure --- ventilation, vacuum chambers, space simulation chambers
[DLR-FB-77-53] N78-31400
**ISOTOPE SEPARATION**
Experimental studies of electron impact depopulation of excited states of atoms: Application to laser development for fusion and isotope separation
[COO-4199-1] N78-31884
**ITALY**
AGRESTE project: Agricultural resources investigations in northern Italy and southern France
[E78-10199] N78-31497


## J


**JAMMING**
Performance in a jamming environment of a low-cost GRS user receiver algorithm for aiding a tactical INS
[AD-A055239] N78-31078
Charge Injection Device (CID) Hadamard plane processor for image bandwidth compression
N78-31309
The effect of polarization diversity on receiving systems
[AD-A055450] N78-31345
**JAPAN**
Investigation of methylpentene polymer (CPX) molding resin
[BDX-613-1905-REV] N78-31248
**JET AIRCRAFT NOISE**
An acoustic field generated by subsonic jets at low Reynolds numbers
N78-31870
**JET ENGINE FUELS**
Antimisting fuel spillage/airshear tests at Naval Weapons Center
[AD-A056113] N78-31256
**JET ENGINES**
Alternatives for jet engine control
[NASA-CR-157578] N78-31107
Status of the Air Force's F-16 aircraft program
[PB-280304/7] N78-31946
**JOINTS (JUNCTIONS)**
Residual strength tests on fatigue-cracked multi-fastener specimens of extruded L.65 aluminum alloy
[ARL-STRUC-NOTE-444] N78-31458
Spacesuit mobility joints
[NASA-CASE-ARC-11058-1] N78-31735
**JOSEPHSON JUNCTIONS**
A theoretical and experimental study of Josephson frequency mixers for heterodyne reception in the submillimetre wavelength range
[ESA-CR(P)-1063] N78-31348
**JOURNAL BEARINGS**
Evaluation of Amper journal bearings for ISEE-B boom hinge
[ESA-ESTL-29] N78-31439


## K


**KALMAN FILTERS**
An extended Kalman filter fire control system against air-to-air missiles volume I
[AD-A055179] N78-31090
Investigation of real-time satellite-to-satellite tracking using extended Kalman filters
[AD-A055115] N78-31148
A generalized Monte Carlo analysis program for Kalman filter design with application to an aircraft-to-satellite tracking filter
[AD-A055189] N78-31156
Basic optimal estimation and control problems in Hilbert space
[AD-A055614] N78-31864
Resolution space, networks, and non-self-adjoint spectral theory II
[AD-A055613] N78-31865
**KANSAS**
Problems associated with maintenance of channel capacity below federal reservoirs in Kansas
[PB-280560/4] N78-31522
**KERNEL FUNCTIONS**
Computer program specification for security kernel for PDP-11/45, volume I
[AD-A054247] N78-31764
Some path properties of p-TH order and symmetric stable processes
[AD-A055844] N78-31857
**KEROSENE**
Antimisting fuel spillage/airshear tests at Naval Weapons Center
[AD-A056113] N78-31256
**KIDNEYS**
Analytical study of electrophoretic characterization of kidney cells --- conducted during the Apollo Soyuz Test Project
[NASA-CR-150790] N78-31713
**KINEMATICS**
Dynamics of a three degree of freedom kinematic chain
[AD-A055612] N78-31840
**KINETIC ENERGY**
Thermal and kinetic analysis of the pyrolysis of coals
[EPRI-AF-528] N78-31552
**KINETIC EQUATIONS**
Functional analytic treatment of linear transport equations in kinetic theory and neutron transport theory
N78-31888
**KINETICS**
Structure and dynamics of organic materials under high pressure
N78-31167
**KOLMOGOROFF-SMIRNOFF TEST**
Kolmogorov-Smirnov test statistics for the gamma distribution with unknown parameters
N78-31850
Simulation study of the power of the Kolmogoroff-Smirnoff and Z tests for the exponential distribution
[NASA-TP-1311] N78-31854
**KRYPTON**
Injection locked, unstable resonator KrF discharge laser with linewidth of 3 GHz
[UCRL-80495] N78-31421


## L


**LAGOONS**
Surface hydrodynamical models through synoptic interpretation of LANDSAT MSS images in lagoonal and coastal waters
[E78-10188] N78-31487
**LAKES**
Effects of diversion and alum application on two eutrophic lakes
[PB-280983/8] N78-31624
**LAMINAR BOUNDARY LAYER**
Boundary-layer and inverse potential-flow methods for axisymmetric bodies
[AD-A054759] N78-31387
A simple finite-difference technique for the computation of threedimensional incompressible laminar boundary layers. Part 2: Description of the program
[NLR-TR-76086-U-PT-2] N78-31398
**LAMINAR FLOW**
Laminar flow-field computation in axisymmetric nozzles
[RAE-TR-77175] N78-31059
Instability, transition to turbulence and predictability
[AGARD-AG-236] N78-31401
**LAND USE**
Evaluation of orbital images as a basis for land utilization
[E78-10187] N78-31486
Use of LANDSAT imagery for soil survey
[E78-10189] N78-31488
Procedures for gathering ground truth information for a supervised approach to a computer implemented land cover classification of LANDSAT acquired multispectral scanner data --- Mississippi
[E78-10198] N78-31496
A summary of the users perspective of LANDSAT-D and reference document of LANDSAT users
[E78-10208] N78-31506
**LANDING AIDS**
Simulation and flight evaluation of a head-up landing aid for general aviation
[NASA-TP-1276] N78-31101

Parameters of future ATC systems relating to airport capacity/delay
[AD-A055482] N78-31130
LANDSAT D
A summary of the users perspective of LANDSAT-D and reference document of LANDSAT users
[E78-10208] N78-31506
An evaluation of the first four LANDSAT-D thematic mapper reflective sensors for monitoring vegetation: A comparison with other satellite sensor systems
[NASA-TM-79617] N78-31510
LANDSAT SATELLITES
LANDSAT policy issues still unresolved
[PB-279701/7] N78-31517
LANDSAT 1
LANDSAT-1 and LANDSAT-2 flight evaluation report
[E78-10205] N78-31503
LANDSAT 2
LANDSAT-1 and LANDSAT-2 flight evaluation report
[E78-10205] N78-31503
LANTHANUM ALLOYS
Spacecraft charging control by thermal, field emission with lanthanum-hexaboride emitters
[NASA-TM-78990] N78-32014
LARGE AREA CROP INVENTORY EXPERIMENT
Nationwide forestry applications program: Procedure 1 applicability to rangeland classification --- Weld County, Colorado
[E78-10202] N78-31500
Linear feature selection with applications
[E78-10206] N78-31504
LARGE SPACE STRUCTURES
Model verification of large structural systems --- space shuttle model response
[NASA-CR-150811] N78-31464
LASER APPLICATIONS
Use of a semiconductor laser in infrared spectroscopy --- air pollution monitoring
[IS-T-786] N78-31196
A laser scanner for 35mm film
[NASA-CR-150810] N78-31412
The laser lightning rod system: A feasibility study
[AD-A055255] N78-31417
Optical difference frequency generation of far infrared radiation
N78-31895
LASER FUSION
Experimental studies of electron impact depopulation of excited states of atoms: Application to laser development for fusion and isotope separation
[COO-4199-1] N78-31884
Raman sidescatter instability in a nonuniform plasma --- laser fusion
N78-31902
LASER MATERIALS
Output power variations in Nd:YAG laser hosts --- yttrium-aluminum garnet
[AD-A055180] N78-31416
Radiation damage of laser materials. A bibliography with abstracts
[NTIS/PS-78/0516/1] N78-31424
LASER OUTPUTS
Output power variations in Nd:YAG laser hosts --- yttrium-aluminum garnet
[AD-A055180] N78-31416
LASER PLASMA INTERACTIONS
Magnetic fields in laser pellet plasmas
N78-31903
LASER PUMPING
Reaction-R constants and simple rate theories applied to the mercury-chloride laser
[AD-A055229] N78-31419
Experimental studies of electron impact depopulation of excited states of atoms: Application to laser development for fusion and isotope separation
[COO-4199-1] N78-31884
LASER RANGE FINDERS
A comparative study of optimum and suboptimum direct-detection laser ranging receivers
[NASA-TP-1315] N78-31413
Earth orientation from lunar laser range-differencing
[NASA-CR-157592] N78-32027
LASERS
The development and application of new experimental laboratory techniques and equipment for measuring laser energy attenuation in the atmosphere
[AD-A055082] N78-31415
Forbidden transition selenium atom photodissociation lasers
[UCRL-80490] N78-31422
An experimental investigation of the effect of 1.06 micrometers laser light on the transparent ocular media
[AD-A055650] N78-31719
LATERAL STABILITY
Analysis of stability contributions of high dihedral V-tails
[NASA-TM-78729] N78-31044
LATITUDE
Computing LORAN time differences with an HP-25 hand calculator
[NASA-CR-157580] N78-31067
LATTICE PARAMETERS
Vibrational relaxation and energy transfer of matrix isolated HCl and DCl
[LBL-7344] N78-31885
LAVAL NUMBER
The determination of the Laval nozzle exit conditions at too high counterpressure, especially for a propane oxygen gas generator
[DLR-FB-77-45] N78-31057
LEAD [METAL]
Measuring and predicting the dynamic effects of a confined thin metal plate pulse heated into the liquid-vapor regime
[UCRL-52375] N78-31475
Air quality criteria for lead
[PB-280411/0] N78-31730
LEAD ACID BATTERIES
Design and cost study for development of lead-acid batteries suitable for electric vehicle propulsion
[ANL-K-77-3624-1] N78-31548
LEAD TITANATES
Quantizing the polarization of lead zirconate-titanate
[LBL-7322] N78-31937
LEAKAGE
Hazards of organic working fluids
[BNL-50761] N78-31725
LENSES
An experimental investigation of the effect of 1.06 micrometers laser light on the transparent ocular media
[AD-A055650] N78-31719
LETHALITY
Behavior, ecology and toxicity of venomous marine fishes
[AD-A054925] N78-31692
LEVITATION
Vibration aspects of ride quality modeling for the DOT TACV: Theory and experiment
[PB-279846/0] N78-31744
LIBRARIES
Copyrights. A bibliography with abstracts
[NTIS/PS-78/0529/4] N78-31959
LIFE [DURABILITY]
Analyzing availability and readiness using transfer function models and cross spectral analysis
[AD-A055724] N78-31447
LIFE CYCLE COSTS
Estimated costs of extended low-rate airframe production
[AD-A054834] N78-31100
LIFE RAFTS
Inflatable liferaft tests in the Pacific Ocean of the Columbia River Bar
[AD-A055323] N78-31065
LIFE SUPPORT SYSTEMS
An evaluation of the fluidic oxygen partial pressure sensor
[AD-A055362] N78-31743
LIGHT [VISIBLE RADIATION]
Light on light: Satyendra Nath Bose's work on radiative equilibrium --- quantum statistics
[ORO-3992-307] N78-31942
LIGHT ADAPTATION
Contrast sensitivity of the human visual system at one luminance level while adapted to a stimulus at another luminance level
[AD-A055238] N78-31717
LIGHT BEAMS
Streak camera time calibration procedures
[NASA-CR-157573] N78-31403
LIGHT ELEMENTS
Gamma ray astronomy and the origin of the light nuclei --- cosmic ray and interstellar gas reactions
N78-31986
LIGHT EMISSION
GEODSS experimental test system participation in Project EXCEDE --- tracking optical emissions induced in the atmosphere by an energetic electron source
[AD-A055264] N78-31642
Laboratory measurement of the solar remission factor g sub 1, 0 of the NO gamma band at 2147 A for the determination of the density of nitric oxide in the D-region of the ionosphere
[DLR-FB-77-30] N78-31653
LIGHT EMITTING DIODES
Electro-optical processing of signals and images
N78-31308
LIGHT SCATTERING
An experimental investigation of the effect of 1.06 micrometers laser light on the transparent ocular media
[AD-A055650] N78-31719
Theoretical and experimental aspects of light scattering from the surface of liquid mercury
N78-31897
Brillouin scattering of reflected light by the bulk acoustic phonons in GaAs and CdS
N78-31923
LIGHTNING SUPPRESSION
The laser lightning rod system: A feasibility study
[AD-A055255] N78-31417
LINE SPECTRA
CCPD: The optimum solid-state line scanner
N78-31303
Quantum theory of cyclotron resonance lineshape for the inversion layer electrons in Metal-Oxide-Semiconductor [MOS]
N78-31925
Gamma ray spectroscopy in astrophysics --- conferences
[NASA-TM-79619] N78-31971
Mechanisms and sites for astrophysical gamma ray line production
N78-31972
Gamma ray spectroscopy in astrophysics: An observational overview [50 keV-20 MeV]
N78-31973
Gamma ray emission and solar flares
N78-31975
Planetary gamma-ray spectroscopy
N78-31976
Search for broad gamma ray lines with the UCR double Compton scatter telescope
N78-31981
Rice University observations of the galactic center
N78-31982
Observational evidence for extraterrestrial gamma-ray line sources
N78-31983
Gamma-ray lines form neutron stars as probes of fundamental physics
N78-31985
Galactic center iron line emission
N78-31987
Gamma line radiation from supernovae --- nucleosynthesis
N78-31988
Gamma-ray line emission above 8 MeV
N78-31990
Cyclotron lines form Her X-1
N78-31991
Confidence about line features in Her X-1 spectrum
N78-31992
Upper limits on the cyclotron lines from Her X-1 as observed with OSO-8
N78-31993
The transfer of cyclotron lines through the magnetospheric shell of Hercules X-1
N78-31997
Cross sections relevant to gamma ray astronomy
N78-32006
LINEAR AMPLIFIERS
Linear 1 kW multitone troposcatter TWT
[AD-A055667] N78-31370
LINEAR ARRAYS
A high performance CCD Linear Imaging Array
N78-31310
LINEAR FILTERS
Investigation of optimal linear shift-invariant two-dimensional digital filters
[AD-A055449] N78-31369
Variable metric methods and filtering theory
[AD-A055828] N78-31859
LINEAR PROGRAMMING
Linear programming in management. A bibliography with abstracts
[NTIS/PS-78/0604/5] N78-31619
Degeneracy in special purpose primal algorithms used in obtaining least absolute value estimators
[AD-A055042] N78-31838
LINEARITY
Linear feature selection with applications
[E78-10206] N78-31504
LIQUID COOLING
Cryogenic recovery analysis of forced flow supercritical helium cooled superconductors
[WFPS-TME-039] N78-31273
LIQUID HYDROGEN
Study of fuel systems for LH2-fueled subsonic transport aircraft, volume 1
[NASA-CR-145369-VOL-1] N78-31085
Study of fuel systems for LH2-fueled subsonic transport aircraft, volume 2
[NASA-CR-145369-VOL-2] N78-31086
LIQUID LITHIUM
TADIRAN high energy lithium batteries --- inorganic thionyl-chloride electrolytes
[LBR-1501] N78-31544
LIQUID OXYGEN
Safety analysis LOX-30 liquid oxygen generator
[AD-A054804] N78-31063
LIQUID PROPELLANT ROCKET ENGINES
Liquid rocket engine axial-flow turbopumps
[NASA-SP-8125] N78-31164
Energy losses in high energy rocket engines with thrust variation
[DLR-FB-77-41] N78-31166
LIQUID ROCKET PROPELLANTS
Hot gas side heat transfer coefficients in high energy rocket engines with thrust variation
[DLR-FB-77-42] N78-31165
An investigation of high pressure gaseous injections into liquid propellants
[AD-A055989] N78-31262
LIQUID SODIUM
Three-dimensional inelastic analysis of a small liquid sodium valve
[HEDL-TME-77-91] N78-31435

**LIQUIDS**
Nonlinear treatment of self-diffusion in liquids --- incoherent scattering law
N78-31185
Piezo-optic properties of liquids under high pressure --- interferometry of refractive index variations
N78-31898

**LITHIUM**
Background of a shielded Ge[Li] spectrometer at balloon altitudes
N78-32001

**LITHIUM ALLOYS**
Lithium compatibility research: Status and requirements for ferrous materials
[CONF-780308-6] N78-31224

**LITHIUM SULFUR BATTERIES**
TADIRAN high energy lithium batteries --- inorganic thionyl-chloride electrolytes
[LBR-1501] N78-31544

**LIVER**
The effect of high altitude on pyridine nucleotides and adenosine phosphates in the liver of the rat
N78-31689

**LOADS [FORCES]**
Hardboard-webbed I-beams: Effects of long-term loading and loading environment
[AD-A055006] N78-31469

**LOGARITHMS**
Equation of state of vanadium
[UCID-17696] N78-31226

**LOGIC CIRCUITS**
The monolithic integration of surface acoustic wave and semiconductor circuit elements on silicon for matched filter device development
N78-31295

**LONG TERM EFFECTS**
Hardboard-webbed I-beams: Effects of long-term loading and loading environment
[AD-A055006] N78-31469
Remeasurement of permanent vegetation plots in the Great Smoky Mountains National Park, Tennessee, USA, and the implications of climatic change on vegetation
[ORNL-TM-6083] N78-31515
Late biological effects of ionizing radiation as influenced by dose, dose rate, age at exposure, and genetic sensitivity to neoplastic transformation
[LA-UR-78-681] N78-31724

**LONGITUDE**
Computing LORAN time differences with an HP-25 hand calculator
[NASA-CR-157580] N78-31067

**LOOPS**
A new loop structure for distributed microcomputing systems
N78-31760
Resonant absorption of Alfvenic surface waves and the heating of solar coronal loops
N78-32030

**LORAN C**
Computing LORAN time differences with an HP-25 hand calculator
[NASA-CR-157580] N78-31067
Phase-locked tracking loops for LORAN-C
[NASA-CR-157582] N78-31068
Loran-C flight test software
[NASA-CR-157581] N78-31069

**LUBRICATING OILS**
Identification of wear particles, Part 1: preliminary investigations --- metal particles in lubricating oils
[AD-A055126] N78-31240

**LUGS**
Constant-amplitude and program-load fatigue tests at low cyclic frequencies on thick aluminium alloy pin joints
[ARL-STRUC-REPT-365] N78-31457

**LUMINOUS INTENSITY**
Contrast sensitivity of the human visual system at one luminance level while adapted to a stimulus at another luminance level
[AD-A055238] N78-31717

**LUNAR CRUST**
Crustal evolution inferred from Apollo magnetic measurements
[NASA-TM-78524] N78-32029

**LUNAR RANGEFINDING**
Earth orientation from lunar laser range-differencing
[NASA-CR-157592] N78-32027

**LUNAR TIDES**
M2 ocean tide parameters and the deceleration of the moon's mean longitude from satellite orbit data
[NASA-TM-79571] N78-32028

**LUNGS**
Factors determining maximal expiratory flows in the human lung
N78-31711


# M


**MACH NUMBER**
Results of a wind tunnel and flight test program to develop a Maximum Volume Bomb [MVB configuration for multiple carriage and separation from tactical-aircraft at mach numbers from 0.50 to 1.10
[AD-A055029] N78-31051

**MACHINE ORIENTED LANGUAGES**
Decompilation
N78-31759

**MACHINE TRANSLATION**
Simulation of the direct execution of a higher order language
[AD-A055235] N78-31798

**MACHINE-INDEPENDENT PROGRAMS**
A machine independent algorithm for code generation and its use in retargetable compilers
N78-31789

**MAGMA**
Study of magma sources, mantle structure and the differentiation of the earth from variations of Nd-143/Nd-144 in igneous rocks
N78-31630

**MAGNESIUM**
Electrical profiling of magnesium implanted gallium phosphide
[AD-A055195] N78-31929

**MAGNESIUM ALLOYS**
Structure of gain boundaries in silicon nitride based alloys --- electron microscopy of MgO, Y2O3, and magnesium-sialon
[LBL-6985] N78-31177

**MAGNETIC COILS**
Cryogenic recovery analysis of forced flow supercritical helium cooled superconductors
[WFPS-TME-039] N78-31273

**MAGNETIC CONTROL**
Study of attitude control systems using the earth's magnetic field at synchronous altitudes
[ESS/SS-834] N78-31154

**MAGNETIC FIELDS**
Tunable magnetoelastic surface wave oscillators
N78-31287
The utility of surface magnetic field measurements in the MAGSAT program
[NASA-TM-79614] N78-31635
Aerial gamma ray and magnetic survey, Van Horn and Pecos Quadrangles, Texas, volume I
[GJBX-2-78-VOL-1] N78-31650
Electroreceptors in man and other animals
N78-31696
Proliferation of bone marrow cells under the influence of superhigh intensity steady magnetic fields
N78-31707
Magnet effects in biology
N78-31709
Magnetic fields in laser pellet plasmas
N78-31903
Resonance oscillations near the lower hybrid frequency in a bounded plasma in a strong magnetic field
N78-31904
Dynamics of incommensurate charge density waves in electric and magnetic fields
N78-31911
Piezoresistivity and its magnetic field dependence in N-type indium-antimonide
N78-31914

**MAGNETIC FILMS**
Electromagnetic penetration depth in superconducting alloys containing magnetic impurities
[COO-1198-1193] N78-31868

**MAGNETIC FLUX**
Nuclear gamma rays from stellar flares
N78-31977

**MAGNETIC INDUCTION**
A wire passing by a circular aperture in an infinite ground plane
[AD-A055583] N78-31340

**MAGNETIC MATERIALS**
A study of the geochemistry of pelagic sediments: The interaction of trace metals and magnetic minerals with sedimentary environments
N78-31631

**MAGNETIC MEASUREMENT**
Crustal evolution inferred from Apollo magnetic measurements
[NASA-TM-78524] N78-32029

**MAGNETIC PERMEABILITY**
Magnetic susceptibility of AnRe2 compounds
[CONF-771127-15] N78-31195

**MAGNETIC PROPERTIES**
Unusual magnetic properties in two copper [II] chelates of Schiff bases derived from alpha-amino acids: A dimeric interaction in a structural linear chain
[AD-A055101] N78-31168
Microstructure and magnetic properties of Fe-Cr-Co-V alloys
[LBL-6931] N78-31225
Magnetic interactions in the hubbard model
N78-31922

**MAGNETIC SUSPENSION**
TLV [Tracked Levitated Vehicle] status report
[PB-279845/2] N78-31961

**MAGNETOELASTIC WAVES**
Tunable magnetoelastic surface wave oscillators
N78-31287

**MAGNETOHYDRODYNAMIC GENERATORS**
Axial field limitations in MHD generators
N78-31905

**MAGNETOHYDRODYNAMIC STABILITY**
Effects of pressure anisotropy on the stability of the guiding center plasma
[ORO-5260-1] N78-31907

**MAGNETOHYDRODYNAMIC WAVES**
Alfven/ion cyclotron waves and the ion cyclotron instability in the earth's magnetosphere
N78-31628
Resonant absorption of Alfvenic surface waves and the heating of solar coronal loops
N78-32030

**MAGNETOSPHERE**
Alfven/ion cyclotron waves and the ion cyclotron instability in the earth's magnetosphere
N78-31628

**MAGNETRONS**
Marx bank and magnetron circuit model
[UCID-17747] N78-31371

**MAGNITUDE**
Seismic magnitude estimates, with a minimum number of detections
[FOA-C-20232-T1] N78-31655
Reevaluation of Modified Mercalli Intensity Scale for earthquakes using distance as determinant
[PB-281459/8] N78-31657

**MAGNUS EFFECT**
Theoretical and experimental methods in the solution of missile nonlinear roll problems
[AD-A055718] N78-31152

**MAINTENANCE**
Proceedings of AFOSR/AFML Corrosion Workshop
[AD-A055281] N78-31218

**MALFUNCTIONS**
Multistate reliability models: A survey
[AD-A055111] N78-31446

**MAN ENVIRONMENT INTERACTIONS**
Energy analysis of order-disorder phenomenon of man and nature
N78-31565

**MAN MACHINE SYSTEMS**
HISS: An approach to hierarchical system sharing for laboratory computers
[AD-A055152] N78-31769
A formal approach to discourse anaphora
[AD-A055671] N78-31810

**MANAGEMENT**
Background storage management in operating systems for communication computers
[DLR-FB-77-37] N78-31821

**MANAGEMENT INFORMATION SYSTEMS**
Simulation of the acquisition management information system
[AD-A055209] N78-31945

**MANAGEMENT METHODS**
Briefing on Department of Energy --- management of energy programs
[GPO-20-083] N78-31542

**MANAGEMENT PLANNING**
A demonstration of areawide water resources planning --- district of columbia
[PB-280750/1] N78-31521
Public participation in water resources planning: A case study and literature review
[PB-280968/9] N78-31524
Briefing on Department of Energy --- management of energy programs
[GPO-20-083] N78-31542
Linear programming in management. A bibliography with abstracts
[NTIS/PS-78/0604/5] N78-31619
Decision making in management. A bibliography with abstracts
[NTIS/PS-78/0605/2] N78-31947
A statistical sampling of cities: Current and projected involvement in fire prevention and control master planning
[PB-279922/9] N78-31963

**MANAGEMENT SYSTEMS**
Filling of orbital fluid management systems
[NASA-CR-159404] N78-31380
Operation Breakthrough site management systems and pneumatic trash collection, executive summary
[PB-280143/9] N78-31962
Evaluation of the refuse management system at the Jersey City operation breakthrough site
[PB-280551/3] N78-31965

**MANIPULATORS**
A comparison of control modes for time delayed remote manipulation
N78-31737
Dynamics of a three degree of freedom kinematic chain
[AD-A055612] N78-31840

**MANNED SPACE FLIGHT**
Evolution of the space suit
N78-31695
Astronauts and cosmonauts biographical and statistical data, revised 31 May 1978
[GPO-30-531] N78-32035
**MANUAL CONTROL**
Is man the weakest link? --- real time activity recording of aircrew workloads
N78-31746
**MANUFACTURING**
IC fabrication using electron-beam technology
[AD-A055610] N78-31368
Study of hybrid power structures
[ESA-CR[P]-1075] N78-31375
**MAPS**
Array scanning techniques
[AD-A055176] N78-31359
Aerial gamma ray and magnetic survey, Van Horn and Pecos Quadrangles, Texas, volume 1
[GJBX-2-78-VOL-1] N78-31650
**MARINE BIOLOGY**
Diversity of stream communities under conditions of pollution stress
[PB-280500/0] N78-31622
Supplemental data report on investigations of marine dissolved organic matter protonation equilibria
[AD-A055157] N78-31682
**MARINE ENVIRONMENTS**
High-frequency techniques and over-the-horizon radar in coastal research
[AD-A054846] N78-31332
Experimental investigation of the marine boundary layer in support of air pollution studies in the Los Angeles air basin
[AD-A054239] N78-31592
**MARSHLANDS**
Coastal marsh productivity: A bibliography
[PB-281089/3] N78-31688
**MARTENSITE**
Engineering design data and correlations for nitinol devices --- austenitic martensitic phase transformations
N78-31206
**MARYLAND**
Proceedings of the Bi-state Conference on the Chesapeake Bay --- emphasis on water pollution control
[PB-282155/1] N78-31626
Some problems of Maryland towns as seen by their mayors
[NASA-TM-79618] N78-31960
Gamma ray facilities at the University of Maryland cyclotron --- data acquisition and radiation measurement
N78-32008
**MASS DISTRIBUTION**
Quartz crystal microbalances: A refined technique for determining changes in mass loading from frequency shifts
[LA-7106-MS] N78-31936
**MASS SPECTROMETERS**
Measurement techniques and applications of charge transfer to aerospace research
[NASA-TM-78734] N78-31404
**MASS SPECTROSCOPY**
The analysis of ambient air using atmospheric pressure chemical ionization mass spectrometry
[UTIAS-219] N78-31591
**MASSACHUSETTS**
Massachusetts coastal zone management program and final environmental impact statement
N78-31681
**MATCHED FILTERS**
The monolithic integration of surface acoustic wave and semiconductor circuit elements on silicon for matched filter device development
N78-31295
**MATERIALS HANDLING**
Effect of handling procedures on sample quality --- organic compounds
[PB-279910/4] N78-31204
Determination of minimum non-propagation distance of aluminum buckets containing 15 pounds of composition A5 --- handling high explosives
[AD-A054737] N78-31259
Critical depth tests of bulk TNT flake explosive --- conveyors for handling explosives safely
[AD-A054739] N78-31260
Dynamic analysis of shipping container suspension system for the canister launched version of the HARPOON missile RGM-84A-3A
[AD-A055719] N78-31433
**MATHEMATICAL MODELS**
Plasticity and variable heredity
[AD-A054254] N78-31214
A nonlinear uniaxial integral constitutive equation incorporative rate effects, creep, and relaxation
[AD-A054252] N78-31216
A new method for solving surface-piercing-strut problems
[AD-A055078] N78-31270
Experiments and analysis of acoustoelectric memory correlators
N78-31296
A wire passing by a circular aperture in an infinite ground plane
[AD-A055583] N78-31340
Multistate reliability models: A survey
[AD-A055111] N78-31446
Time series determination of transfer functions in random fatigue
[AD-A055656] N78-31471
Fundamental stochastic models of the transport of water and solutes through saturated and unsaturated porous media
[PB-279772/8] N78-31519
Energy analysis of models of the United States
N78-31555
Energy models of exchange with simulation of the role of exchange in spatial organization
N78-31559
Energy analysis and models of soil formation
N78-31564
Risk analysis in environmental studies. 1: Risk analysis methodology, a statistical approach. 2: Data management for environmental studies
[RHO-SA-33] N78-31597
Bearing capacity of river ice for vehicles
[AD-A055244] N78-31637
Ion cloud modeling
[AD-A055969] N78-31648
The capability of a network of seismological stations to detect events and to obtain identification parameters
[FOA-C-20231-T1] N78-31654
Mathematical analysis and computer simulation in military mission workload assessment
N78-31758
Stochastic modelling of computer systems and networks
N78-31816
Algebraic simplification of interconnected systems
[UCID-17760] N78-31843
Magnetic interactions in the hubbard model
N78-31922
**MATHEMATICAL PROGRAMMING**
Automated design of structures subject to stress, displacement and temperature constraints
N78-31456
A new class of feasible direction methods
[AD-A055032] N78-31803
**MATHEMATICS**
Report of the 1977 National Survey of science, mathematics, and social studies education
[PB-280192/6] N78-31944
**MATRICES [CIRCUITS]**
Modelization of metal insulating semiconductor devices on CgHgTe application to a charge transfer device for infrared imagery
N78-31301
**MATRICES [MATHEMATICS]**
Maps: A matrix arithmetic programming system
[PB-279859/3] N78-31813
Multidomain algorithm evaluation, volume 1
[AD-A054357] N78-31826
Multidomain algorithm evaluation, volume 2
[AD-A054358] N78-31827
Power comparisons of two-sided tests of equality of two covariance matrices and some distribution theory
N78-31851
**MATRIX METHODS**
On the multiplicity of solutions of the inverse problem for a vibrating beam
[NASA-CR-157572] N78-31466
Preliminary design for multimode matrix perception experiment software
[AD-A055178] N78-31797
**MATTER [PHYSICS]**
Supplemental data report on investigations of marine dissolved organic matter protonation equilibria
[AD-A055157] N78-31682
**MAXIMUM LIKELIHOOD ESTIMATES**
Maximum likelihood identification of the longitudinal aerodynamic coefficients of the EA-6B airplane in the catapult launch configuration
[AD-A054243] N78-31046
Application of a maximum likelihood parameter estimator to an advanced missile guidance and control system
[AD-A055188] N78-31149
Estimation of the operating characteristics of the two-parameter beta method
[AD-A055611] N78-31860
**MEASURING INSTRUMENTS**
Turbine tip clearance measurement
[AD-A055765] N78-31115
Design definition study of the Earth radiation budget satellite system
[NASA-CR-158934] N78-31140
Tracking servobridge detector, volume 1
[AD-A055083] N78-31356
Tracking servobridge detectors, volume 2
[AD-A055084] N78-31357
Tracking servobridge detectors. Volume 3: Operation sheets
[AD-A055085] N78-31358
Displacement probes with self-contained exciting medium
[NASA-CASE-LAR-11690-1] N78-31406
Instrument to measure the initial deformation of rock around underground openings
[PB-279657/1] N78-31659
A research program to reduce interior noise in general aviation airplanes: Investigation of the characteristics of an acoustic panel test facility
[NASA-CR-157587] N78-31874
**MECHANICAL DEVICES**
Actuator mechanism
[NASA-CASE-GSC-11883-2] N78-31426
**MECHANICAL DRIVES**
Engine/airframe/drive train dynamic interface documentation
[AD-A055766] N78-31114
**MECHANICAL IMPEDANCE**
Transverse compressional damping in the vibratory response of elastic-viscoelastic-elastic beams
[AD-A054769] N78-31468
**MECHANICAL PROPERTIES**
Fabrication and mechanical properties of alumina fiber-alumina matrix composites
N78-31171
The interrelationships of density and fiber orientation on the mechanical properties of fiberboard
N78-31172
Synergistic mechanisms of solid lubricants
[AD-A054741] N78-31243
Mechanical properties of 0.2 g/cm-3 polystyrene bead foam
[BDX-613-1725-REV] N78-31250
Mechanical properties test data for structural materials
[ORNL-5380] N78-31473
Measurements of material properties for solar cells --- aluminum film and KAPTON
[NASA-CR-150797] N78-31531
Mechanical theorem proving and artificial intelligence languages
N78-31781
**MEDICAL ELECTRONICS**
Description and analysis of the Hewlett-Packard 78220 arrhythmia monitoring system
[AD-A055451] N78-31720
**MEDICAL SCIENCE**
Genetics of microorganisms and medicine
N78-31698
Some pressing problems of genetics
N78-31699
**MENISCI**
Segregation freezing as the cause of suction force for ice lens formation --- in soils
[AD-A055780] N78-31647
**MERCURY [METAL]**
Determination of low-level mercury by cold vapor generation and atomic absorption spectroscopy
[ARH-LD-160] N78-31203
Theoretical and experimental aspects of light scattering from the surface of liquid mercury
N78-31897
**MERCURY ARCS**
Hazard analysis of broad-band optical sources
[AD-A054802] N78-31900
**MERCURY TELLURIDES**
Anomalous hall effect and oscillatory photoconductivity in p-type mercury cadmium telluride
N78-31926
**MESONS**
A search for charmed meson production in proton-proton collisions at the CERN-ISR
N78-31887
**METAL BONDING**
The influence of the environment on the elastoplastic properties of adhesives in metal bonded joints --- in aircraft structures
[DLR-FB-77-63] N78-31251
**METAL COATINGS**
Effects of compositional changes on the performance of a thermal barrier coating system --- yttria-stabilized zirconia coatings on gas turbine engine blades
[NASA-TM-78976] N78-31212
**METAL COMBUSTION**
Impact thresholds for the initiation of metal sparking
[AD-A054738] N78-31189
**METAL COMPOUNDS**
Inhibition of hot salt corrosion by metallic additives
[NASA-TM-78966] N78-31208
**METAL FIBERS**
Fabrication and mechanical properties of alumina fiber-alumina matrix composites
N78-31171
**METAL FILMS**
Reproducible adhesion test for soldered thick-film conductors
[AD-A054971] N78-31361
Absorptance of IR laser radiation at a metallic interface at various angles of incidence and polarizations
[AD-A055256] N78-31418
Direct observation of grain boundary diffusion by scanning Auger microscopy --- scanning electron microscopy of metal films
[COO-2679-14] N78-31935

**METAL IONS**
Transition metal ion binding by ferritin as studies by electron paramagnetic resonance spectroscopy
N78-31184
Multiheteromacrocycles that complex metal ions
[SAN-34P218X4] N78-31194
**METAL JOINTS**
Constant-amplitude and program-load fatigue tests at low cyclic frequencies on thick aluminium alloy pin joints
[ARL-STRUC-REPT-365] N78-31457
**METAL MATRIX COMPOSITES**
Fabrication and mechanical properties of alumina fiber-alumina matrix composites
N78-31171
Fabrication of graphite-aluminum composites via pultrusion
[AD-A055257] N78-31173
**METAL OXIDE SEMICONDUCTORS**
Quantum theory of cyclotron resonance lineshape for the inversion layer electrons in Metal-Oxide-Semiconductor [MOS]
N78-31925
Radiation effects on MOS/SOS semiconductor devices --- defects in aluminum oxide crystals
[AD-A055925] N78-31934
**METAL OXIDES**
Longitudinal shear behavior of several oxide dispersion strengthened alloys
[NASA-TM-78973] N78-31211
**METAL PARTICLES**
Identification of wear particles, Part 1: preliminary investigations --- metal particles in lubricating oils
[AD-A055126] N78-31240
**METAL PLATES**
Development of plating thickness standards
[BDX-613-1709-REV] N78-31272
Measuring and predicting the dynamic effects of a confined thin metal plate pulse heated into the liquid-vapor regime
[UCRL-52375] N78-31475
**METAL SURFACES**
EPRI-NASA cooperative project on stress corrosion cracking of Zircaloys --- nuclear fuel failures
[NASA-CR-157577] N78-31230
**METAL-NITRIDE-OXIDE-SILICON**
Design of a microprocessor based system for testing of the NCR 2051 MNOS memory
[AD-A055200] N78-31767
Use of a metal-nitride-oxide-semiconductor as the detector for a radiation dosimeter
[AD-A055187] N78-31932
**METALS**
Fundamental studies of metal fluorination reactions
[COO-2671-7] N78-31202
Plasticity and variable heredity
[AD-A054254] N78-31214
The constant volume hypothesis for the inelastic deformation of metals in the small strain range
[AD-A054253] N78-31215
A nonlinear uniaxial integral constitutive equation incorporative rate effects, creep, and relaxation
[AD-A054252] N78-31216
The role of passive film growth kinetics and properties in stress corrosion and crevice corrosion susceptibility
[AD-A055366] N78-31219
Cyclic ductility cyclic strength and fatigue crack propagation of metals and alloys
[AD-A055359] N78-31220
High performance metal/air fuel cells. Part 1: General review
[UCID-17558-PT-1] N78-31549
Deep Ocean Mining Environmental Study [DOMES]. Unpublished manuscript number 20. Data report: Trace metals - DOMES samples
[PB-281098/4] N78-31687
Statistical properties of particles confined by irregular surfaces
N78-31918
**METASTABLE ATOMS**
Experimental studies of electron impact depopulation of excited states of atoms: Application to laser development for fusion and isotope separation
[COO-4199-1] N78-31884
**METEOROLOGICAL CHARTS**
Meteorological and oceanographic observations on board Netherlands lightvessels in the North Sea, 1971
[KNMI-141-23] N78-31678
**METEOROLOGICAL INSTRUMENTS**
Instruments for measuring the amount of moisture in the air
[NASA-TM-78190] N78-31405
Atmospheric density measurement in the middle atmosphere --- betasonde
[AD-A055773] N78-31646
Physically-based high resolution surface wind and temperature analysis for EPAMS
[AD-A055861] N78-31673
**METEOROLOGICAL PARAMETERS**
Atmospheric conditions at the High Energy Laser Systems Test Facility [HELSTF], White Sands Missile Range, New Mexico 24 March to 8 April 1977
[AD-A055028] N78-31571
Stochastic modelling of site wind characteristics
[RLO-2342-77/2] N78-31675
Meteorological and oceanographic observations on board Netherlands lightvessels in the North Sea, 1971
[KNMI-141-23] N78-31678
**METEOROLOGICAL SATELLITES**
The GISS sounding temperature impact test
[NASA-TM-78063] N78-31667
World Weather Watch. The role of satellites in WMO programmes in the 1980s
[WMO-494] N78-31676
**METHODOLOGY**
Current knowledge on numerical data indexing and possible future developments
[PB-279924/5] N78-31953
**METHYL ALCOHOLS**
Distribution of naphthalene between commercial resins and water-methanol solutions
[IS-T-802] N78-31193
**METRIC SPACE**
Integral formulation of Einstein's equations and Mach's principle
N78-31866
**MICROBALANCES**
Quartz crystal microbalances: A refined technique for determining changes in mass loading from frequency shifts
[LA-7106-MS] N78-31936
**MICROCHANNELS**
MCP glass analysis studies
[AD-A055251] N78-31242
**MICROCOMPUTERS**
Microcomputers: General applications. Citations from the NTIS data base
[NTIS/PS-78/0609/4] N78-31773
Microcomputers. Part 1: General applications. Citations from the engineering index data base
[NTIS/PS-78/0611/0] N78-31774
Microcomputers. Volume 4, Part 1: General applications. Citations from the engineering index data base
[NTIS/PS-78/0612/8] N78-31775
Microcomputers. Volume 3, part 2: Telecommunication applications. Citations from the engineering index data base
[NTIS/PS-78/0613/6] N78-31776
Microcomputers. Volume 3, part 3: Basic design and development. Citations from the engineering index data base
[NTIS/PS-78/0614/4] N78-31777
Microcomputers. Volume 4, part 3: Basic design and development: Citations from the engineering index data base
[NTIS/PS-78/0615/1] N78-31778
Microcomputers. Part 4: Process control applications. Citations from the engineering index data base
[NTIS/PS-78/0616/9] N78-31779
**MICROELECTRONICS**
Hybrid microcircuit failure rate prediction
[AD-A055756] N78-31367
**MICROORGANISMS**
Genetics of microorganisms and medicine
N78-31698
**MICROPROCESSORS**
Loran-C flight test software
[NASA-CR-157581] N78-31069
A microprocessor controlled electrically programmable transversal filter
N78-31292
Design of a microprocessor based system for testing of the NCR 2051 MNOS memory
[AD-A055200] N78-31767
Xerox controller design
[AD-A055224] N78-31771
Microcomputers: General applications. Citations from the NTIS data base
[NTIS/PS-78/0609/4] N78-31773
Microcomputers. Part 1: General applications. Citations from the engineering index data base
[NTIS/PS-78/0611/0] N78-31774
Microcomputers. Volume 4, Part 1: General applications. Citations from the engineering index data base
[NTIS/PS-78/0612/8] N78-31775
Microcomputers. Volume 3, part 2: Telecommunication applications. Citations from the engineering index data base
[NTIS/PS-78/0613/6] N78-31776
Microcomputers. Volume 3, part 3: Basic design and development. Citations from the engineering index data base
[NTIS/PS-78/0614/4] N78-31777
Microcomputers. Volume 4, part 3: Basic design and development. Citations from the engineering index data base
[NTIS/PS-78/0615/1] N78-31778
Microcomputers. Part 4: Process control applications. Citations from the engineering index data base
[NTIS/PS-78/0616/9] N78-31779
A real-time language or small processors: Design, definition, and implementation
N78-31784
**MICROSCOPY**
Identification of wear particles, Part 1: preliminary investigations --- metal particles in lubricating oils
[AD-A055126] N78-31240
**MICROSTRUCTURE**
Microstructure and magnetic properties of Fe-Cr-Co-V alloys
[LBL-6931] N78-31225
**MICROWAVE AMPLIFIERS**
Monolithic 20W 2GHz transistor and monolithic 5W 4GHz transistor
[AD-A055249] N78-31360
A method for the exact determination of noise parameters of active twoports in the frequency range 1 GHz to 11 GHz
[RAE-LIB-TRANS-1963] N78-31877
**MICROWAVE EQUIPMENT**
Demonstration of the microwave ice protection concept
[AD-A055824] N78-31096
Broadband modem II
[AD-A055269] N78-31334
**MICROWAVE LANDING SYSTEMS**
TRSB microwave landing system demonstration program at John F. Kennedy International Airport, Long Island, New York, USA
[AD-A055447] N78-31070
TRSB microwave landing system demonstration program at Kristiansand, Norway
[AD-A055317] N78-31071
TRSB microwave landing system demonstration program at Charleroi, Belgium
[AD-A055920] N78-31072
**MICROWAVE TRANSMISSION**
Design, fabrication and testing of a CFA for use in the solar power satellite
[NASA-CR-159410] N78-31143
Microwave electric power transmission. A bibliography with abstracts
[NTIS/PS-78/0580/7] N78-31379
**MICROWAVE TUBES**
Design, fabrication and testing of a CFA for use in the solar power satellite
[NASA-CR-159410] N78-31143
**MICROWAVES**
Microwave surface-acoustic-wave components
N78-31283
**MIDAIR COLLISIONS**
Some important results obtained in the analysis of near midair and midair collisions
[DLR-FB-77-25] N78-31081
**MILITARY AIR FACILITIES**
AFAL simulation facility/capability manual. Volume 1: Executive summary and Systems Avionics Division
[AD-A055591] N78-31102
Analysis of vector wind change with respect to time for Vandenberg Air Force Base, California
[NASA-CR-150776] N78-31663
**MILITARY AIRCRAFT**
Technical evaluation of flying weapon systems
[RAE-LIB-TRANS-1948] N78-31087
Community noise exposure resulting from aircraft operations. Volume 5: Acoustic data on Air Force propeller aircraft
[AD-A055079] N78-31593
**MILITARY AVIATION**
Status of the Air Force's F-16 aircraft program
[PB-280304/7] N78-31946
**MILITARY HELICOPTERS**
Methodological considerations of visual workloads of helicopter pilots --- eye movement measurements
N78-31747
Preliminary design of an accident Information Retrieval System [AIRS]
[AD-A055590] N78-31952
**MILITARY OPERATIONS**
Status of the NAVSTAR global positioning system
[PB-280316/1] N78-31082
Mathematical analysis and computer simulation in military mission workload assessment
N78-31758
**MILLIMETER WAVES**
The 20/30 GHz satellite systems technology needs assessment
[NASA-TM-78975] N78-31323
**MILLING [MACHINING]**
Effect of attrition milling on the reaction sintering of silicon nitride
[NASA-TM-78965] N78-31236
**MINERAL DEPOSITS**
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 1 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157600] N78-31511
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 2 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157601] N78-31512
Deep Ocean Mining Environmental Study [DOMES]. Unpublished manuscript number 20. Data report: Trace metals - DOMES samples
[PB-281098/4] N78-31687

**MINERALS**
Collected summaries of works dealing with the application of LANDSAT imagery in the survey of mineral resources
[E78-10191] N78-31490
A summary of the users perspective of LANDSAT-D and reference document of LANDSAT users
[E78-10208] N78-31506

**MINICOMPUTERS**
Design and implementation of an adaptable compiler for minicomputer type architecture
N78-31761
Software tool {S} for evaluating the effects of finite wordlength
[AD-A055777] N78-31806
A distributed mini-computer network
[AD-A055254] N78-31820

**MINING**
The relative costs of producing syncrude from oil shales of various grades under varying conditions
[ERG-022] N78-31268
Water quality management guidance for mine-related pollution sources [new, current and abandoned]
[PB-280625/5] N78-31616
Deep Ocean Mining Environmental Study [DOMES]. Unpublished manuscript number 20. Data report: Trace metals - DOMES samples
[PB-281098/4] N78-31687

**MIRRORS**
The steering problem for the mirror-scan tracking system. Part 1: The stop-go-stop procedure
[AD-A055125] N78-31336

**MIS {SEMICONDUCTORS}**
Modelization of metal insulating semiconductor devices on CgHgTe application to a charge transfer device for infrared imagery
N78-31301

**MISSILE CONTROL**
Application of a maximum likelihood parameter estimator to an advanced missile guidance and control system
[AD-A055188] N78-31149

**MISSILE SYSTEMS**
Technical evaluation of flying weapon systems
[RAE-LIB-TRANS-1948] N78-31087

**MISSILE TRAJECTORIES**
An extended Kalman filter fire control system against air-to-air missiles volume I
[AD-A055179] N78-31090

**MISSILES**
The use of ram rockets for high altitude missiles
[DLR-FB-77-47] N78-31153

**MISSION PLANNING**
Definition study of a multidisciplinary European mission. Volume 1: Executive summary
[ESS/SS-777] N78-31138
HEAO C-1 gamma-ray spectrometer --- experimental design
N78-32011
The gamma ray observatory
N78-32013
Astrometry satellite. Theoretical study of the accuracy. Volume 1: Models and algorithms
[ESA-CR[P]-1068-VOL-1] N78-32024
Astrometry satellite. Theoretical study of the accuracy. Volume 2: Numerical experiments
[ESA-CR[P]-1068-VOL-2] N78-32025
The energetic particle environment of the solar probe mission: As estimated by the participants of the Solar Probe Environment Workshop
[NASA-CR-157595] N78-32032

**MISSISSIPPI**
Procedures for gathering ground truth information for a supervised approach to a computer implemented land cover classification of LANDSAT acquired multispectral scanner data --- Mississippi
[E78-10198] N78-31496

**MISSOURI**
Remote sensing applications to Missouri environmental resources information system
[E78-10209] N78-31507
Secondary treatment of municipal wastewater in the St. Louis Area - minimal impact expected
[PB-280965/5] N78-31969

**MITOSIS**
Proliferation of bone marrow cells under the influence of superhigh intensity steady magnetic fields
N78-31707

**MIXING CIRCUITS**
A theoretical and experimental study of Josephson frequency mixers for heterodyne reception in the submillimetre wavelength range
[ESA-CR[P]-1063] N78-31348
Analysis of receiver mixers
[AD-A055283] N78-31362

**MIXTURES**
On thermodynamics and the nature of the second law for mixtures of interacting continua
[AD-A055102] N78-31940

**MODAL RESPONSE**
Model verification of large structural systems --- space shuttle model response
[NASA-CR-150811] N78-31464

**MODELS**
Radar image modeling and processing for real-time RF simulation
[AD-A055060] N78-31333
Surface hydrodynamical models through synoptic interpretation of LANDSAT MSS images in lagoonal and coastal waters
[E78-10188] N78-31487
Operator workload assessment model: An evaluation of a VF/VA-V/STOL system
N78-31757

**MODEMS**
Broadband modem II
[AD-A055269] N78-31334

**MOISTURE CONTENT**
Material evaluation of polyurethane foam, 0.05 g/cm3 density
[BDX-613-1836-REV] N78-31249
Instruments for measuring the amount of moisture in the air
[NASA-TM-78190] N78-31405

**MOLDING MATERIALS**
Investigation of methylpentene polymer {CPX} molding resin
[BDX-613-1905-REV] N78-31248

**MOLECULAR BEAMS**
Measurement techniques and applications of charge transfer to aerospace research
[NASA-TM-78734] N78-31404

**MOLECULAR FLOW**
Molecular two-dimensional flow of mixtures of light and heavy gases with diffuse and specular reflection --- preliminary experiments for Spacelab
[DLR-FB-77-51] N78-31060

**MOLECULAR ORBITALS**
Molecular orbital calculations on molecules of Air Force interest --- TNT decomposition and pyrolytic products in rocket exhausts
[AD-A055072] N78-31881

**MOLECULAR RELAXATION**
Vibrational relaxation and energy transfer of matrix isolated HCl and DCl
[LBL-7344] N78-31885

**MOLECULAR SPECTROSCOPY**
Computer identification of infrared spectra by correlation-based file searching
[AD-A055277] N78-31770

**MOLECULES**
Nonlinear optical polarizabilities of molecules --- in gases and vapors
N78-31894

**MOLLUSKS**
Results of benthic studies at Calvert cliffs
[PB-280279/1] N78-31685

**MOLTEN SALT ELECTROLYTES**
Physical properties data compilations relevant to energy storage. 1. Molten salts: Eutectic data --- bibliography
[PB-280795/6] N78-31589

**MOMENTS**
Method of moment thin wire computer program comparisons for complex structures and coarse accuracy
[AD-A055759] N78-31341

**MOMENTS OF INERTIA**
A variable inertia flywheel as an energy storage system
N78-31529

**MONOMERS**
The vinyl reactivity of [eta[5]-vinylcyclopentadienyl] dicarbonyl nitrosylchromium. A novel vinyl organometallic monomer
[AD-A055012] N78-31169
Infrared studies of the solid state polymerization of diacetylene monomers
[AD-A055988] N78-31244

**MONOPOLE ANTENNAS**
Analysis of monopole antenna arrays on cylinders by the geometrical theory of diffraction
[AD-A055197] N78-31335

**MONOPULSE RADAR**
Operation of SAW reflective array pulse compressors in a high performance radar with minus 0.4 meter range resolution
N78-31315

**MONTE CARLO METHOD**
A Monte Carlo analysis of science instrument scan sequences for unmanned missions to the planets
N78-31136
A generalized Monte Carlo analysis program for Kalman filter design with application to an aircraft-to-satellite tracking filter
[AD-A055189] N78-31156
Probability intervals for the reliability of complex systems using Monte Carlo simulation
[PB-280191/8] N78-31449
Investigation to compute the distribution of fatigue life by Monte-Carlo methods
[FB-138[1978]] N78-31462

**MOON-EARTH TRAJECTORIES**
M2 ocean tide parameters and the deceleration of the moon's mean longitude from satellite orbit data
[NASA-TM-79571] N78-32028

**MOSSBAUER EFFECT**
An analysis of metallic glasses by Mossbauer spectroscopy
[AD-A055073] N78-31241

**MULTIPROCESSING {COMPUTERS}**
A fault-tolerant multiprocessor architecture for aircraft, volume 1 --- autopilot configuration
[NASA-CR-3010] N78-31818

**MULTIPROGRAMMING**
Implementation of algorithms for performance analysis of a class of multiprogrammed computers
[FUB-25-1977] N78-31811

**MULTISPECTRAL BAND SCANNERS**
Analytical techniques for the study of some parameters of multispectral scanner systems for remote sensing
[E78-10200] N78-31498

**MULTIVARIATE STATISTICAL ANALYSIS**
Multistate reliability models: A survey
[AD-A055111] N78-31446
Analysis of vector wind change with respect to time for Cape Kennedy, Florida
[NASA-CR-150779] N78-31665
On the dual-adaptive control and its practical applications
[CEPHAG-52/77] N78-31832
A robust class of tests and estimates for multivariate location based on ranks
N78-31852
MANOVA multiple comparisons associated with finite intersection tests
[AD-A055842] N78-31858
Variable metric methods and filtering theory
[AD-A055828] N78-31859

**MUTATIONS**
Late biological effects of ionizing radiation as influenced by dose, dose rate, age at exposure, and genetic senitivity to neoplastic transformation
[LA-UR-78-681] N78-31724


## N


**N-TYPE SEMICONDUCTORS**
Piezoresistivity and its magnetic field dependence in N-type indium-antimonide
N78-31914

**NAPHTHALENE**
Distribution of naphthalene between commercial resins and water-methanol solutions
[IS-T-802] N78-31193

**NASA PROGRAMS**
EPRI-NASA cooperative project on stress corrosion cracking of Zircaloys --- nuclear fuel failures
[NASA-CR-157577] N78-31230
High altitude perspective --- cost-reimbursable services using NASA U-2 aircraft
[NASA-SP-427] N78-31508
LANDSAT policy issues still unresolved
[PB-279701/7] N78-31517
Energy: A continuing bibliography with indexes, issue 17
[NASA-SP-7043[17]] N78-31530
Aeronautics and space report of the President: The 1977 activities
N78-32015
The energetic particle environment of the solar probe mission: As estimated by the participants of the Solar Probe Environment Workshop
[NASA-CR-157595] N78-32032

**NATIONAL AIRSPACE UTILIZATION SYSTEM**
Baseline National Airspace Data Interchange Network [NADIN] data base
[AD-A056112] N78-31949

**NATURAL LANGUAGE {COMPUTERS}**
The discourse and reference components of PAL
[AD-A055046] N78-31801
An annotated bibliography of natural language and speech understanding systems
[AD-A055863] N78-31808

**NAVIGATION AIDS**
Search and rescue methods and equipment. A bibliography with abstracts
[NTIS/PS-78/0539/3] N78-31066
Status of the NAVSTAR global positioning system
[PB-280316/1] N78-31082

**NAVIGATION INSTRUMENTS**
A modular adaptive, variable function flight control sensor
[AD-A055175] N78-31120

**NAVSTAR SATELLITES**
Status of the NAVSTAR global positioning system
[PB-280316/1] N78-31082

**NAVY**
US Navy fleet aviation training program development
[AD-A055788] N78-31734

**NEODYMIUM ISOTOPES**
Study of magma sources, mantle structure and the differentiation of the earth from variations of Nd-143/Nd-144 in igneous rocks
N78-31630

**NEODYMIUM LASERS**
Output power variations in Nd:YAG laser hosts --- yttrium-aluminum garnet
[AD-A055180] N78-31416
**NEOPLASMS**
Late biological effects of ionizing radiation as influenced by dose, dose rate, age at exposure, and genetic sensitivity to neoplastic transformation
[LA-UR-78-681] N78-31724
**NERVOUS SYSTEM**
Dependence of the reaction of the human nervous system on the distribution of absorbed doses of ionizing radiation
N78-31704
**NETWORK ANALYSIS**
Implementation of algorithms for performance analysis of a class of multiprogrammed computers
[FUB-25-1977] N78-31811
Symmetry, automorphism and test
[CEPHAG-46/77] N78-31844
The simplex SON algorithm for LP/embedded network problems
[AD-A055156] N78-31863
**NETWORK SYNTHESIS**
A new loop structure for distributed microcomputing systems
N78-31760
The simplex SON algorithm for LP/embedded network problems
[AD-A055156] N78-31863
**NEUTRON SCATTERING**
Microscopic theory of charge density wave instability in NbSe2
[CONF-7709106-1] N78-31197
**NEUTRON STARS**
Nuclear gamma rays from compact objects --- nuclear interactions around neutron stars and black holes
N78-31984
Gamma-ray lines form neutron stars as probes of fundamental physics
N78-31985
Cyclotron emission in neutron star magnetospheres
N78-31995
The transfer of cyclotron lines through the magnetospheric shell of Hercules X-1
N78-31997
**NEUTRONS**
Functional analytic treatment of linear transport equations in kinetic theory and neutron transport theory
N78-31888
**NEW ENGLAND [US]**
Computer processing of LANDSAT digital data and sensor interface development for use in New England reservoir management
[AD-A055762] N78-31513
Research needs relating to on-site Treatment of Domestic Wastes: Summary of Workshop
[PB-280989/5] N78-31966
**NEW JERSEY**
Evaluation of the refuse management system at the Jersey City operation breakthrough site
[PB-280551/3] N78-31965
**NEWTON-RAPHSON METHOD**
The development of quasi-Newton methods for unconstrained minimisation --- of nonlinear functions
[RAE-TR-77132] N78-31845
**NICKEL**
Effects of thermomechanical processing on strength and toughness of iron - 12-percent-nickel - reactive metal alloys at -196 C
[NASA-TP-1308] N78-31213
**NICKEL ALLOYS**
Engineering design data and correlations for nitinol devices --- austenitic martensitic phase transformations
N78-31206
Longitudinal shear behavior of several oxide dispersion strengthened alloys
[NASA-TM-78973] N78-31211
**NICKEL CADMIUM BATTERIES**
Alternate power sources session: Nuclear battery hybrid configuration study
[AD-A055182] N78-31546
**NICKEL COMPOUNDS**
Design and cost study of a nickel-iron oxide battery for electric vehicles. Volume 2: Public report
[ANL-K-3723-1] N78-31551
**NICKEL STEELS**
Mechanical stability of retained austenite in tempered 9Ni steel
[AD-A055240] N78-31217
**NIGHT VISION**
Correlations between night vision tests
[FOA-C-56014-H9] N78-31726
**NIOBIUM COMPOUNDS**
Microscopic theory of charge density wave instability in NbSe2
[CONF-7709106-1] N78-31197
**NIOBIUM STANNIDES**
Electron tunneling into the A15 superconductors: Nb3Sn, V3Si, and Nb3Ge
N78-31924
**NITRAMINE PROPELLANTS**
Nitramine propellants --- gun propellant burning rate
[NASA-CASE-NPO-14103-1] N78-31255
**NITRIC OXIDE**
Laboratory measurement of the solar remission factor g sub 1, 0 of the NO gamma band at 2147 A for the determination of the density of nitric oxide in the D-region of the ionosphere
[DLR-FB-77-30] N78-31653
**NITROGEN**
The reduction of molecular nitrogen, organic substrates and protons by vanadium[II]
N78-31181
**NITROGEN DIOXIDE**
Nitrogen dioxide photolytic, radiometric, and meteorological field data
[PB-279999/7] N78-31604
**NITROGEN OXIDES**
Control techniques for nitrogen oxides emissions from stationary sources - second edition
[PB-280034/0] N78-31612
Procedures for quantifying relationships between photochemical oxidants and precursors: Supporting documentation
[PB-280058/9] N78-31614
Nitrogen oxides: Current status of knowledge
[EPRI-EA-668] N78-31723
**NITROGLYCERIN**
Engineering feasibility study for elimination of nitroglycerin from solvent vapors
[AD-A055980] N78-31192
**NITROSAMINE**
Nitrosamines
[PB-280479/7] N78-31727
**NOISE [SOUND]**
Initial investigation of stationary hydrofoil cavitation and cavitation noise scaling
[AD-A055260] N78-31271
Optimum quantization for memoryless detection in M-dependent noise
[AD-A055174] N78-31768
**NOISE GENERATORS**
Noise generation and noise propagation in centrifugal fans
[DLR-IB-257-78/1] N78-31879
**NOISE INTENSITY**
Hypothetical case studies of operational changes to reduce noise levels
[AD-A055066] N78-31878
**NOISE MEASUREMENT**
Noise measurements of an aluminum gravitational radiation antenna at 5 to 9 Kelvin
N78-31320
Community noise exposure resulting from aircraft operations. Volume 5: Acoustic data on Air Force propeller aircraft
[AD-A055079] N78-31593
A method for the exact determination of noise parameters of active twoports in the frequency range 1 GHz to 11 GHz
[RAE-LIB-TRANS-1963] N78-31877
**NOISE POLLUTION**
Highway traffic noise. A bibliography with abstracts
[NTIS/PS-78/0634/2] N78-31620
Federal noise research in noise effects
[PB-280335/1] N78-31733
The influence of background noise level and signal duration on the judged annoyance of aircraft noise
[UTIAS-228] N78-31875
**NOISE PROPAGATION**
Experimental investigation of outdoor propagation of finite-amplitude noise --- aircraft noise
[NASA-CR-2992] N78-31876
Noise generation and noise propagation in centrifugal fans
[DLR-IB-257-78/1] N78-31879
**NOISE REDUCTION**
Helicopter transmission vibration and noise reduction program. Volume 1: Technical report
[AD-A055104] N78-31089
Adaptive Kalman type estimation applied to image processing
[AD-A055827] N78-31365
A research program to reduce interior noise in general aviation airplanes: Noise reduction through a cavity-backed flexible plate
[NASA-CR-157588] N78-31873
A research program to reduce interior noise in general aviation airplanes: Investigation of the characteristics of an acoustic panel test facility
[NASA-CR-157587] N78-31874
**NOISE TEMPERATURE**
Noise measurements of an aluminum gravitational radiation antenna at 5 to 9 Kelvin
N78-31320
**NONAQUEOUS ELECTROLYTES**
TADIRAN high energy lithium batteries --- inorganic thionyl-chloride electrolytes
[LBR-1501] N78-31544
**NONDESTRUCTIVE TESTS**
Development of plating thickness standards
[BDX-613-1709-REV] N78-31272
Nondestructive ultrasonic testing and inspection, volume 2. Citations from the Engineering Index data base
[NTIS/PS-78/0567/4] N78-31450
Nondestructive ultrasonic testing and inspection, volume 3. Citations from the Engineering Index data base
[NTIS/PS-78/0568/2] N78-31451
Nondestructive ultrasonic testing and inspection, volume 4. Citations from the NTIS data base
[NTIS/PS-78/0565/8] N78-31452
Nondestructive ultrasonic testing and inspection, volume 5. Citation from the NTIS data base
[NTIS/PS-78/0566/6] N78-31453
Comparison of soil moduli obtained from nondestruction dynamic testing and constitutive equations
[AD-A055670] N78-31649
Interactive signal analysis and ultrasonic data collection system user's manual
[NASA-CR-150798] N78-31763
**NONLINEAR SYSTEMS**
Optimization and estimation in nonlinear systems with application to inertial guidance
N78-31139
Investigations of self organizing control laws and possibilities of their realization
[DLR-FB-77-57] N78-31833
**NONLINEARITY**
Nonlinear treatment of self-diffusion in liquids --- incoherent scattering law
N78-31185
**NONUNIFORM FLOW**
Analysis of multistage, axial flow turbomachine wake production, transport, and interaction
[AD-A055754] N78-31118
**NONUNIFORM PLASMAS**
Raman sidescatter instability in a nonuniform plasma --- laser fusion
N78-31902
**NORTH CAROLINA**
Pavement design manual for secondary roads in North Carolina
[PB-280971/3] N78-31275
**NORTH SEA**
Meteorological and oceanographic observations on board Netherlands lightvessels in the North Sea, 1971
[KNMI-141-23] N78-31678
**NORTHERN HEMISPHERE**
A model for the atmospherically forced circulation in an ocean basin
N78-31680
**NORWAY**
TRSB microwave landing system demonstration program at Kristiansand, Norway
[AD-A055317] N78-31071
**NOVAE**
Gamma ray lines from novae --- stellar mass ejection
N78-31989
**NOZZLE FLOW**
Laminar flow-field computation in axisymmetric nozzles
[RAE-TR-77175] N78-31059
Multi-purpose wind tunnel reaction control model block
[NASA-CASE-MSC-19706-1] N78-31129
**NUCLEAR ELECTRIC POWER GENERATION**
Analysis of nuclear systems satisfying US energy needs
[GA-A-14848] N78-31891
**NUCLEAR FISSION**
An acceptance nuclear fission future --- by assurances of nuclear reactor safety
[ORAU/IEA[M]-77-29] N78-31890
**NUCLEAR FUELS**
EPRI-NASA cooperative project on stress corrosion cracking of Zircaloys --- nuclear fuel failures
[NASA-CR-157577] N78-31230
**NUCLEAR FUSION**
Gamma line radiation from supernovae --- nucleosynthesis
N78-31988
**NUCLEAR INTERACTIONS**
Nuclear gamma rays from compact objects --- nuclear interactions around neutron stars and black holes
N78-31984
**NUCLEAR MAGNETIC RESONANCE**
Optical rotary saturation --- double resonance interaction
N78-31896
**NUCLEAR PARTICLES**
Gamma ray astronomy and the origin of the light nuclei --- cosmic ray and interstellar gas reactions
N78-31986
**NUCLEAR POWER PLANTS**
Probability intervals for the reliability of complex systems using Monte Carlo simulation
[PB-280191/8] N78-31449
**NUCLEAR RADIATION**
ORIS: The Oak Ridge Imaging System program listings
[ORNL-TM-5875-V3] N78-31722
Nuclear gamma rays from stellar flares
N78-31977

The nuclear radiation monitor for the Spacelab/Shuttle
N78-32003

NUCLEAR REACTOR CONTROL
Enhancing public acceptance of nuclear energy by improving reactor safety systems
[ORAE/IEA[R]-77-28] N78-31889

NUCLEAR REACTORS
Toward an acceptable nuclear future --- by assurances of nuclear reactor safety
[ORAU/IEA[O]-77-31] N78-31892

NUCLEATION
Nucleation phenomena in the formation electron-hole drops in Ge
N78-31910

NUCLEI [NUCLEAR PHYSICS]
Gamma ray astronomy and the origin of the light nuclei --- cosmic ray and interstellar gas reactions
N78-31986

NUMBER THEORY
Measures on the integers and limit distributions of additive, number-theoretic functions
N78-31848

NUMERICAL ANALYSIS
Numerical analysis of flow fields generated by accelerating flames
[LBL-7233] N78-31199
Numerical procedure to determine geometric view factors for surfaces occluded by cylinders
[NASA-TM-78740] N78-31354
Verification of a three-dimensional turbulent boundary-layer calculation method
[AD-A055606] N78-31388
Numerical algorithms for nonlinearly constrained optimization
N78-31790
Software tool (S) for evaluating the effects of finite wordlength
[AD-A055777] N78-31806
Numerical minimization methods for functionals: Comparison and extensions
[UTIAS-209] N78-31835

NUTRITION
Nitrosamines
[PB-280479/7] N78-31727

## O

OCEAN BOTTOM
A study of the geochemistry of pelagic sediments: The interaction of trace metals and magnetic minerals with sedimentary environments
N78-31631
Deep Ocean Mining Environmental Study (DOMES). Unpublished manuscript number 20. Data report: Trace metals - DOMES samples
[PB-281098/4] N78-31687

OCEAN CURRENTS
A model for the atmospherically forced circulation in an ocean basin
N78-31680
Deep Ocean Mining Environmental Study, DOMES. Unpublished manuscript no. 12: Lagrangian diffusion parameters in the surface water of the tropical North Pacific Ocean
[PB-281388/9] N78-31683
Observations of the Antarctic polar front by a moored array during FDRAKE-76
[PB-281460/6] N78-31686

OCEAN SURFACE
The geoid spectrum from altimetry
[NASA-TM-79583] N78-31633
Deep Ocean Mining Environmental Study, DOMES. Unpublished manuscript no. 12: Lagrangian diffusion parameters in the surface water of the tropical North Pacific Ocean
[PB-281388/9] N78-31683

OCEANOGRAPHIC PARAMETERS
Meteorological and oceanographic observations on board Netherlands lightvessels in the North Sea, 1971
[KNMI-141-23] N78-31678

OCEANOGRAPHY
National Ocean Survey, Fiscal year 1977
[PB-281390/5] N78-31684

OCULOMETERS
An experimental investigation of the effect of 1.06 micrometers laser light on the transparent ocular media
[AD-A055650] N78-31719

ODORS
Physical and chemical phenomena responsible for odor formation in diesel engines
[PB-280544/8] N78-31621

OH-6 HELICOPTER
Evaluation of a circulation control tail boom for yaw control --- OH-6 helicopter
[AD-A055116] N78-31119

OIL EXPLORATION
A summary of the users perspective of LANDSAT-D and reference document of LANDSAT users
[E78-10208] N78-31506
Energy analysis and oil shale reserves
[ERG-023] N78-31584

OIL RECOVERY
The relative costs of producing syncrude from oil shales of various grades under varying conditions
[ERG-022] N78-31268
Energy analysis and oil shale reserves
[ERG-023] N78-31584

OPERATING SYSTEMS [COMPUTERS]
HISS: An approach to hierarchical system sharing for laboratory computers
[AD-A055152] N78-31769
Background storage management in operating systems for communication computers
[DLR-FB-77-37] N78-31821
Link invariant line programs in communication systems
[DLR-FB-77-38] N78-31822

OPERATIONS RESEARCH
An M/M/1 dynamic priority queue with optional promotion
N78-31824

OPERATOR PERFORMANCE
The human operator simulator: Workload estimation using a simulated secondary task
N78-31756

OPERATORS [MATHEMATICS]
An analysis of observed system sensitivity to plant parameter variations
[AD-A055190] N78-31829
Basic optimal estimation and control problems in Hilbert space
[AD-A055614] N78-31864
Resolution space, networks, and non-self-adjoint spectral theory II
[AD-A055613] N78-31865

OPTICAL MEASURING INSTRUMENTS
Development and fabrication of a prototype Fibrous Aerosol Monitor [FAM]
[PB-280126/4] N78-31613

OPTICAL POLARIZATION
Nonlinear optical polarizabilities of molecules --- in gases and vapors
N78-31894

OPTICAL PROPERTIES
Measurements of material properties for solar cells --- aluminum film and KAPTON
[NASA-CR-150797] N78-31531
Atmospheric conditions at the High Energy Laser Systems Test Facility [HELSTF], White Sands Missile Range, New Mexico 24 March to 8 April 1977
[AD-A055028] N78-31671

OPTICAL RADAR
A comparative study of optimum and suboptimum direct-detection laser ranging receivers
[NASA-TP-1315] N78-31413

OPTICAL RESONANCE
Optical rotary saturation --- double resonance interaction
N78-31896

OPTICAL SCANNERS
Array scanning techniques
[AD-A055176] N78-31359
A laser scanner for 35mm film
[NASA-CR-150810] N78-31412

OPTICAL TRACKING
Satellite optical tracking: Spin decay and flash observations
N78-32019

OPTIMAL CONTROL
Trajectory optimization for some sailplane performance problems
N78-31083
Optimum quantization for memoryless detection in M-dependent noise
[AD-A055174] N78-31768

OPTIMIZATION
Control system design using vector-valued performance criteria with application to the control rate reduction in parameter insensitive control systems
[DLR-FB-77-55] N78-31125
Review of methods for description of random transmission channels applications to identification and optimisation of detection and transmission processes
[CEPHAG-35/77] N78-31347
Use of eye-movement measures to establish design parameters for helicopter instrument panels
N78-31748
Numerical algorithms for nonlinearly constrained optimization
N78-31790
A dual optimization framework for some problems of information theory and statistics
[AD-A055155] N78-31802
Numerical minimization methods for functionals: Comparison and extensions
[UTIAS-209] N78-31835
Combinatorial optimization: What is the state of the art
[AD-A055722] N78-31842
The development of quasi-Newton methods for unconstrained minimisation --- of nonlinear functions
[RAE-TR-77132] N78-31845
Stability and multicriteria optimization
N78-31862

ORBIT TRANSFER VEHICLES
Orbit Transfer Vehicle [OTV] engine phase A study
[NASA-CR-150796] N78-31163

ORBITAL ELEMENTS
LANDSAT-1 and LANDSAT-2 flight evaluation report
[E78-10205] N78-31503

ORBITAL POSITION ESTIMATION
Investigation of real-time satellite-to-satellite tracking using extended Kalman filters
[AD-A055115] N78-31148

ORBITS
Filling of orbital fluid management systems
[NASA-CR-159404] N78-31380

ORGANIC COMPOUNDS
The reduction of molecular nitrogen, organic substrates and protons by vanadium[II]
N78-31181
Effect of handling procedures on sample quality --- organic compounds
[PB-279910/4] N78-31204
Organic emissions from automobile interiors --- indoor air pollution
[PB-280374/0] N78-31605
Organic characterization of aerosols and vapor phase compounds in urban atmospheres
[PB-280050/6] N78-31611

ORGANIC LIQUIDS
Hazards of organic working fluids
[BNL-50761] N78-31725

ORGANIC MATERIALS
Supplemental data report on investigations of marine dissolved organic matter protonation equilibria
[AD-A055157] N78-31682

ORGANOMETALLIC COMPOUNDS
The vinyl reactivity of [eta[5]-vinylcyclopentadienyl] dicarbonyl nitrosylchromium. A novel vinyl organometallic monomer
[AD-A055012] N78-31169
Multiheteromacrocycles that complex metal ions
[SAN-34P218X4] N78-31194
Inhibition of hot salt corrosion by metallic additives
[NASA-TM-78966] N78-31208

OSCILLATORS
Influence of acceleration on surface acoustic wave oscillators
N78-31286

OSO-8
Upper limits on the cyclotron lines from Her X-1 as observed with OSO-8
N78-31993
High energy X-ray spectra of cygnus XR-1 observed from OSO-8
[NASA-TM-79626] N78-32017

OUTGASSING
Organic emissions from automobile interiors --- indoor air pollution
[PB-280374/0] N78-31605

OUTPUT
Comparison of energy analysis of oil shale
N78-31563

OVER-THE-HORIZON RADAR
High-frequency techniques and over-the-horizon radar in coastal research
[AD-A054846] N78-31332

OXIDATION-REDUCTION REACTIONS
Synergistic mechanisms of solid lubricants
[AD-A054741] N78-31243

OXIDIZERS
Investigation of propellant and explosive solid solution systems II X-ray studies
[AD-A055981] N78-31263

OXYGEN
Activated gas reactions with silicone and epoxy resins
[SAND-77-1429C] N78-31201

OXYGEN ISOTOPES
Measurements of 15.11-MeV gamma-ray flux produced in the reactions C-12[p, p']-C-12'[15.11 MeV] and O-16[p, p' alpha]-C-12'[15.11 MeV]
N78-32007

OXYGEN METABOLISM
The effect of high altitude on pyridine nucleotides and adenosine phosphates in the liver of the rat
N78-31689

OXYGEN SUPPLY EQUIPMENT
An evaluation of the fluidic oxygen partial pressure sensor
[AD-A055362] N78-31743

OZONE
Simultaneous measurements of ozone outside and inside cabins of two B-747 airliners and a Gates Learjet business jet
[NASA-TM-78983] N78-31061
Nitrogen dioxide photolytic, radiometric, and meteorological field data
[PB-279999/7] N78-31604
Procedures for quantifying relationships between photochemical oxidants and precursors: Supporting documentation
[PB-280058/9] N78-31614

# P

**PACIFIC NORTHWEST [US]**
Integrating policy analysis: Study module 7. Volume 2: Technical appendix
[PB-280037/3] N78-31587

**PACIFIC OCEAN**
Deep Ocean Mining Environmental Study, DOMES. Unpublished manuscript no. 12: Lagrangian diffusion parameters in the surface water of the tropical North Pacific Ocean
[PB-281388/9] N78-31683

**PACKINGS [SEALS]**
Solar energy systems. Standards for rubber seals
[PB-280114/0] N78-31444

**PAIR PRODUCTION**
Gamma ray polarimetry --- compton scattering and pair production
[CONTRIB-156] N78-32004

**PAKISTAN**
Regional investigations of tectonic and igneous geology, Iran, Pakistan, and Turkey
[E78-10197] N78-31495

**PANELS**
Effects of environment, and damping and coupling properties of composite laminates on panel flutter --- airframe materials
[AD-A055753] N78-31175
Use of eye-movement measures to establish design parameters for helicopter instrument panels
N78-31748

**PAPER [MATERIAL]**
Applications of thermal energy storage to process heat storage and recovery in the paper and pulp industry
[NASA-CR-159398] N78-31537

**PARABOLIC ANTENNAS**
Nodding feed antenna for communications with satellites in sychronous orbit
[NASA-TM-78989] N78-31155

**PARACHUTE DESCENT**
Hybrid trajectory simulation of a parachute system --- low impact velocity two parachute system aerodynamics
[SAND-78-8668] N78-31054

**PARALLEL PROGRAMMING**
Computation expressions and their applications in an adaptive computer system
N78-31814
Modelling parallel systems with dynamic structure
N78-31815

**PARAMETERIZATION**
Conditions for strong consistency of M-estimators for location
N78-31846

**PARTICLE ACCELERATORS**
REB focusing in a high-voltage diode --- pulsed electron accelerators
[SAND-78-6005] N78-31883

**PARTICLE COLLISIONS**
Cross sections relevant to gamma ray astronomy
N78-32006

**PARTICLE DIFFUSION**
Diffusion of monoenergetic photoelectron fluxes inside the plasmasphere
[CEPHAG-39/77] N78-31909

**PARTICLE EMISSION**
Design and construction of the Donner 280-crystal positron ring for dynamic transverse section emission imaging
[LBL-5679] N78-31721

**PARTICLE MOTION**
Integral formulation of Einstein's equations and Mach's principle
N78-31866

**PARTICLE PRODUCTION**
A search for charmed meson production in proton-proton collisions at the CERN-ISR
N78-31887

**PARTICLE THEORY**
Light on light: Satyendra Nath Bose's work on radiative equilibrium --- quantum statistics
[ORO-3992-307] N78-31942

**PARTICULATE SAMPLING**
Characterizing high-energy-formed particulates with the scanning electron microscope/energy dispersive spectrometer system
[UCID-17652] N78-31266

**PARTITIONS [MATHEMATICS]**
The simplex SON algorithm for LP/embedded network problems
[AD-A055156] N78-31863

**PASSENGER AIRCRAFT**
GPSS computer simulation of aircraft passenger emergency evacuations
[AD-A056098] N78-31062

**PASSENGERS**
The vibrating environment in transport vehicles: A critical bibliographical study --- human tolerance to vibratory loads
[RAE-LIB-TRANS-1917] N78-31738

**PATHOLOGICAL EFFECTS**
Air quality criteria for lead
[PB-280411/0] N78-31730

**PATTERN RECOGNITION**
Procedures for gathering ground truth information for a supervised approach to a computer implemented land cover classification of LANDSAT acquired multispectral scanner data --- Mississippi
[E78-10198] N78-31496
Syntactic algorithms for image segmentation and a special computer architecture for image processing
N78-31785
An adaptive recognition algorithm for the automatic detection of straight line segments
N78-31787

**PAVEMENTS**
Pavement design manual for secondary roads in North Carolina
[PB-280971/3] N78-31275
Optimization and testing of highway materials to mitigate ice adhesion
[PB-280927/5] N78-31276
Comparison of soil moduli obtained from nondestruction dynamic testing and constitutive equations
[AD-A055670] N78-31649

**PDP 11 COMPUTER**
RSX-11D/DX11-B interface user's guide
[NASA-CR-150809] N78-31795

**PELAGIC ZONE**
A study of the geochemistry of pelagic sediments: The interaction of trace metals and magnetic minerals with sedimentary environments
N78-31631

**PELLETS**
Magnetic fields in laser pellet plasmas
N78-31903

**PERFORMANCE**
Teper technical evaluation program evaluation and restructuring
[AD-A055757] N78-31343
Off design performance of supercharged two stroke diesel engines
N78-31437

**PERFORMANCE PREDICTION**
A theoretical study of the performance of a number of different axial-flow turbine configurations under conditions of pulsating flow
[ARL-MECH-ENG-REPT-149] N78-31104
Hybrid microcircuit failure rate prediction
[AD-A055756] N78-31367
Determination of fatigue performance data on structural materials under typified random loading: Axially loaded notched specimens of mild steel RR St 52 - 3 [SAE 1030]
[TB-127[1978]] N78-31461
Investigation to compute the distribution of fatigue life by Monte-Carlo methods
[FB-138[1978]] N78-31462
Development of a set of general rigid and flexible body equations of motion in coupled form using the direct approach
N78-31867

**PERFORMANCE TESTS**
Inflatable liferaft tests in the Pacific Ocean of the Columbia River Bar
[AD-A055323] N78-31065
Study of hybrid power structures
[ESA-CR[P]-1075] N78-31375
Performance evaluation of wind energy conversion systems using the method of bins: Current status
[SAND-77-1375] N78-31580
A pilot evaluation of two G-seat cueing schemes
[NASA-TP-1255] N78-31739
Implementation of algorithms for performance analysis of a class of multiprogrammed computers
[FUB-25-1977] N78-31811

**PERIODIC VARIATIONS**
Investigations on unsteady pressure distribution measurements in rotating systems
[DLR-FB-77-43] N78-31135
National climate program
[GPO-92-323] N78-31670

**PEROVSKITES**
Surface and bulk electronic properties of d-band perovskites
N78-31916

**PERTURBATION**
Gas response to perturbations in disk galaxies
N78-32026

**PERTURBATION THEORY**
Singular perturbations of semilinear second order systems
[AD-A055279] N78-31837

**PHASE CONTROL**
The monolithic integration of surface acoustic wave and semiconductor circuit elements on silicon for matched filter device development
N78-31295

**PHASE ERROR**
Synthetic Aperture Radar [SAR] system limitations due to phase errors
[DLR-IB-551-77/2] N78-31349

**PHASE LOCKED SYSTEMS**
Phase-locked tracking loops for LORAN-C
[NASA-CR-157582] N78-31068

**PHASE TRANSFORMATIONS**
Engineering design data and correlations for nitinol devices --- austenitic martensitic phase transformations
N78-31206
Form-stable crystalline polymer pellets for thermal energy storage, phase I
[ORO-5159-10] N78-31582
Elastic properties of one-dimensional conductors and semiconductors
N78-31913
Investigation of phase equilibria of TaC fiber reinforced cobalt alloys having a directionally solidified eutectic structure aimed at matrix hardening --- turbine blades
[DLR-FB-77-58] N78-31939

**PHASED ARRAYS**
SAW filter application for phased array radar
N78-31300

**PHONONS**
Microscopic theory of charge density wave instability in NbSe2
[CONF-7709106-1] N78-31197
Brillouin scattering of reflected light by the bulk acoustic phonons in GaAs and CdS
N78-31923

**PHOSPHORUS**
Atmospheric pathways of the phosphorus cycle
N78-31590
Effects of diversion and alum application on two eutrophic lakes
[PB-280983/8] N78-31624

**PHOTOCHEMICAL OXIDANTS**
Procedures for quantifying relationships between photochemical oxidants and precursors: Supporting documentation
[PB-280058/9] N78-31614

**PHOTOCHEMICAL REACTIONS**
Reaction rate and photochemical data for atmospheric chemistry, 1977
[NASA-CR-157610] N78-31607

**PHOTOCHROMISM**
Review of photosensitive materials for holographic recordings
[AD-A055013] N78-31407

**PHOTOCONDUCTIVITY**
Elastophotoconductance in polycrystalline films of cadmium-sulfide
N78-31921
Anomalous hall effect and oscillatory photoconductivity in p-type mercury cadmium telluride
N78-31926

**PHOTODISSOCIATION**
Forbidden transition selenium atom photodissociation lasers
[UCRL-80490] N78-31422

**PHOTOELECTRIC GENERATORS**
Solar central receiver power plants
[SAND-77-8510] N78-31550

**PHOTOELECTRONS**
Diffusion of monoenergetic photoelectron fluxes inside the plasmasphere
[CEPHAG-39/77] N78-31909

**PHOTOGRAPHIC FILM**
Review of photosensitive materials for holographic recordings
[AD-A055013] N78-31407

**PHOTOGRAPHY**
An experimental investigation of the effect of 1.06 micrometers laser light on the transparent ocular media
[AD-A055650] N78-31719

**PHOTOLYSIS**
Nitrogen dioxide photolytic, radiometric, and meteorological field data
[PB-279999/7] N78-31604

**PHOTOMECHANICAL EFFECT**
The photomechanical effects as measured by fracture surface energy in KCl
N78-31917

**PHOTONS**
Thermodynamic interpretation of secondary ion and photon emission during sputtering of silicon
N78-31912

**PHOTOSENSITIVITY**
Review of photosensitive materials for holographic recordings
[AD-A055013] N78-31407

**PHOTOVOLTAIC CONVERSION**
High output solar cell with multilayer AR coating
[AD-A054226] N78-31545

**PHYSICAL PROPERTIES**
Engineering and pedological properties of soils as they affect soil erodibility
[PB-279856/9] N78-31658

**PHYSICS**
Gamma-ray lines form neutron stars as probes of fundamental physics
N78-31985

**PHYSIOLOGICAL EFFECTS**
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 40. Effects on nonionizing electromagnetic radiation
[JPRS-71595] N78-31705

Work Capability and physiological effects Predictive studies. 4: in HE-02 excursions to pressures of 400-800/1200- and 1600 feet of sea water
[NASA-CR-157571] N78-31714
The vibrating environment in transport vehicles: A critical bibliographical study --- human tolerance to vibratory loads
[RAE-LIB-TRANS-1917] N78-31738

PHYSIOLOGICAL RESPONSES
Physiological response to atmospheric pollutants
[PB-280413/6] N78-31731
Physiological measures of workloads: Correlations between physiological parameters and operational performance
N78-31753

PHYSIOLOGICAL TESTS
Correlations between night vision tests
[FOA-C-56014-H9] N78-31726

PIEZOELECTRICITY
Applications of piezoelectric convoluters to radar signal processing
N78-31314
Piezo-optic properties of liquids under high pressure --- interferometry of refractive index variations
N78-31898
Piezoresistivity and its magnetic field dependence in N-type indium-antimonide
N78-31914

PILOT PERFORMANCE
IPC design validation and flight testing
[AD-A055529] N78-31074
Effects of dynamic aeroelasticity on handling qualities and pilot rating
N78-31084
Visual workload of the copilot/navigator during terrain flight
[AD-A055038] N78-31742
Methods to assess work load
[AGARD-CP-216] N78-31745
Methodological considerations of visual workloads of helicopter pilots --- eye movement measurements
N78-31747
Use of eye-movement measures to establish design parameters for helicopter instrument panels
N78-31748
Auditory communication and workload --- human response time measurements to voice communication
N78-31749
Pitch and formant analysis of the voice in the investigation of pilot workshop
N78-31750
Use of Inspiratory Minute Volumes in evaluation of rotary and fixed wing pilot workload --- respiratory response to flight conditions
N78-31754

PINS
Constant-amplitude and program-load fatigue tests at low cyclic frequencies on thick aluminium alloy pin joints
[ARL-STRUC-REPT-365] N78-31457

PIONS
Pionic instabilities in high-energy heavy ion collisions
[LBL-6525] N78-31882

PIPES [TUBES]
An experimental investigation of enhanced heat transfer on horizontal condenser tubes
[AD-A055430] N78-31392

PITCH [INCLINATION]
Effects of dynamic aeroelasticity on handling qualities and pilot rating
N78-31084

PLANETARY RADIATION
Planetary gamma-ray spectroscopy
N78-31976

PLANKTON
Deep Ocean Mining Environmental Study [DOMES]. Unpublished manuscript number 20. Data report: Trace metals - DOMES samples
[PB-281098/4] N78-31687

PLASMA DIFFUSION
A study of the diffusion of tracer impurities in the Versator 1 Tokamak plasma by spectral emissions in the vacuum ultraviolet range
[AD-A054756] N78-31906

PLASMA HEATING
Resonant absorption of Alfvenic surface waves and the heating of solar coronal loops
N78-32030

PLASMA PHYSICS
Magnetic fields in laser pellet plasmas
N78-31903

PLASMA TEMPERATURE
Resonance oscillations near the lower hybrid frequency in a bounded plasma in a strong magnetic field
N78-31904

PLASMA-ELECTROMAGNETIC INTERACTION
Raman sidescatter instability in a nonuniform plasma --- laser fusion
N78-31902

PLASMA-PARTICLE INTERACTIONS
REB focusing in a high-voltage diode --- pulsed electron accelerators
[SAND-78-6005] N78-31883

PLASMAPAUSE
On the relative location of the plasmapause and the HF backscatter curtains
[REPT-23] N78-31636
Diffusion of monoenergetic photoelectron fluxes inside the plasmasphere
[CEPHAG-39/77] N78-31909

PLASMAS [PHYSICS]
RF plasma enhanced vapor deposition and etching of silicon nitride
[SAND-77-2070] N78-31176
Activated gas reactions with silicone and epoxy resins
[SAND-77-1429C] N78-31201
Resonance oscillations near the lower hybrid frequency in a bounded plasma in a strong magnetic field
N78-31904

PLASTIC DEFORMATION
Strain induced plastic-to-rubber transition of an SBS block copolymer and its blend with PS
[AD-A055905] N78-31246

PLASTIC PROPERTIES
Plasticity and variable heredity
[AD-A054254] N78-31214
Crack tip plasticity in dynamic fracture mechanics
[AD-A055159] N78-31470

PLASTICS
Development of a data base for assessing plastic fire hazards
[PB-280027/4] N78-31254

PLATES [STRUCTURAL MEMBERS]
A research program to reduce interior noise in general aviation airplanes: Noise reduction through a cavity-backed flexible plate
[NASA-CR-157588] N78-31873

PLOTTING
INTERPOL: An interactive plotting package for off-line Cal Comp systems
[AD-A054762] N78-31800

PLUMES
Mechanisms of exhaust pollutants and plume formation in continuous combustion
[AD-A054844] N78-31594
Development of vertical dispersion coefficients for deep-valley terrain
[COO-4026-3] N78-31596
Pollutant measurements in plumes from power plants and cities: A project MISTT report, summer 1975, February 1976, and February 1977
[PB-280198/3] N78-31609

PLYWOOD
Hardboard-webbed I-beams: Effects of long-term loading and loading environment
[AD-A055006] N78-31469

POINTING CONTROL SYSTEMS
Digital controller design: Analysis of the annular suspension pointing system --- analog controllers with feedback
[NASA-CR-150807] N78-31825

POLARIMETERS
Gamma ray polarimetry --- compton scattering and pair production
[CONTRIB-156] N78-32004

POLARIZATION [CHARGE SEPARATION]
Quantizing the polarization of lead zirconate-titanate
[LBL-7322] N78-31937

POLARIZATION [SPIN ALIGNMENT]
Turbine tip clearance measurement
[AD-A055765] N78-31115

POLICIES
LANDSAT policy issues still unresolved
[PB-279701/7] N78-31517

POLLUTION CONTROL
Effect of inlet temperature on the performance of a catalytic reactor --- air pollution control
[NASA-TM-78977] N78-31534
Flue gas desulfurization systems: Design and operating considerations. Volume 1: Executive summary
[PB-280253/6] N78-31598
Flue gas desulfurization systems: Design and operating considerations. Volume 2: Technical report
[PB-280254/4] N78-31599
Cleaning coal with coal: Coal humic acids for removal of acids, alkali, salinity, and heavy metal pollutants associated with the use of coal as a fuel
[PB-280580/2] N78-31608
Control techniques for nitrogen oxides emissions from stationary sources - second edition
[PB-280034/0] N78-31612
Physical and chemical phenomena responsible for odor formation in diesel engines
[PB-280544/8] N78-31621
Alternative policies for controlling nonpoint agricultural sources of water pollution
[PB-280757/6] N78-31623
Proceedings of the Bi-state Conference on the Chesapeake Bay --- emphasis on water pollution control
[PB-282155/1] N78-31626

POLLUTION MONITORING
Use of a semiconductor laser in infrared spectroscopy --- air pollution monitoring
[IS-T-786] N78-31196
Air quality data: 1977 first quarter statistics
[PB-280184/3] N78-31600
Air quality data: 1977 second quarter statistics
[PB-280185/0] N78-31601
Air quality data: 1976 fourth quarter statistics
[PB-280186/8] N78-31602
Pollutant measurements in plumes from power plants and cities: A project MISTT report, summer 1975, February 1976, and February 1977
[PB-280198/3] N78-31609
Development and fabrication of a prototype Fibrous Aerosol Monitor [FAM]
[PB-280126/4] N78-31613
Regulations and resource file of continuous monitoring information
[PB-280975/4] N78-31625

POLYAMIDE RESINS
Syntactic foam from silver coated microbubbles
[BDX-613-1790-REV] N78-31247

POLYBENZIMIDAZOLE
Polymeric foams from cross-linkable poly-n-ary lenebenzimidazoles
[NASA-CASE-ARC-11008-1] N78-31232

POLYBUTADIENE
Strain induced plastic-to-rubber transition of an SBS block copolymer and its blend with PS
[AD-A055905] N78-31246

POLYETHYLENES
Form-stable crystalline polymer pellets for thermal energy storage, phase 1
[ORO-5159-10] N78-31582

POLYIMIDE RESINS
Temperature dependence of the dielectric constant of quartz polyimide, part 2
[AD-A055105] N78-31239

POLYIMIDES
Synthesis of perfluoroalkylene aromatic diamines
[NASA-CR-159403] N78-31235

POLYMER CHEMISTRY
Synthesis of thermally stable polymers
[NASA-CR-157360] N78-31234

POLYMERIC FILMS
Proton and electron irradiation of thermal control coatings and polymeric films. Part 1: Experimental part
[ESA-CR[P]-1077-VOL-1] N78-31252
Proton and electron irradiation of thermal control coatings and polymeric films. Part 2: Theoretical part
[ESA-CR[P]-1077-VOL-2] N78-31253

POLYMERIZATION
Polymeric foams from cross-linkable poly-n-ary lenebenzimidazoles
[NASA-CASE-ARC-11008-1] N78-31232
Synthesis of thermally stable polymers
[NASA-CR-157360] N78-31234
Infrared studies of the solid state polymerization of diacetylene monomers
[AD-A055988] N78-31244

POLYSTYRENE
Strain induced plastic-to-rubber transition of an SBS block copolymer and its blend with PS
[AD-A055905] N78-31246
Mechanical properties of 0.2 g/cm-3 polystyrene bead foam
[BDX-613-1725-REV] N78-31250

POLYTETRAFLUOROETHYLENE
Structure and dynamics of organic materials under high pressure
N78-31167

POLYURETHANE FOAM
Material evaluation of polyurethane foam, 0.05 g/cm3 density
[BDX-613-1836-REV] N78-31249

PONDS
Thermal performance measurements on ultimate heat sinks: Cooling ponds
[NUREG/CR-0008] N78-31394

POPULATION INVERSION
Quantum theory of cyclotron resonance lineshape for the inversion layer electrons in Metal-Oxide-Semiconductor [MOS]
N78-31925

POROSITY
Fundamental stochastic models of the transport of water and solutes through saturated and unsaturated porous media
[PB-279772/8] N78-31519

PORTABLE EQUIPMENT
A variant of portable single-channel bioradiotelemetry system
N78-31702

POSITION [LOCATION]
Performance in a jamming environment of a low-cost GRS user receiver algorithm for aiding a tactical INS
[AD-A055239] N78-31078
Statistical model for random errors of position location based on lines of position
[PB-281158/6] N78-31079
Status of the NAVSTAR global positioning system
[PB-280316/1] N78-31082
Calibration and positional determination of Boller and Chivens 31-inch telescope B
[AD-A055266] N78-32020

**POSITRON ANNIHILATION**
Detection of 511 keV positron annihilation radiation from the galactic center direction --- gamma ray astronomy
N78-31978

**POSITRONS**
Design and construction of the Donner 280-crystal positron ring for dynamic transverse section emission imaging
[LBL-5679] N78-31721

**POTASSIUM CHLORIDES**
The photomechanical effects as measured by fracture surface energy in KCl
N78-31917

**POTENTIAL FLOW**
Boundary-layer and inverse potential-flow methods for axisymmetric bodies
[AD-A054759] N78-31387

**POTENTIOMETERS (INSTRUMENTS)**
Potentiometric titration with EDTA using metallic bismuth indicator electrode
[ANL-TRANS-1123] N78-31198

**POURING**
System for vacuum pouring of epoxy tensile and impact specimens with a study of the behavior of these specimens at 77 K and 293 K
[ORNL-TM-5493] N78-31178

**POWDER METALLURGY**
Heat transfer modeling and analytical quenching of a powder metallurgy turbine disk during heat treatment
[AD-A054022] N78-31110

**POWER AMPLIFIERS**
Monolithic 20W 2GHz transistor and monolithic 5W 4GHz transistor
[AD-A055249] N78-31360
Linear 1 kW multitone troposcatter TWT
[AD-A055667] N78-31370

**POWER LINES**
Possibility of attenuating the ecological effects of alternating current power lines as a result of new designs and circuit changes
N78-31708

**POWER SERIES**
Power comparisons of two-sided tests of equality of two covariance matrices and some distribution theory
N78-31851

**POWER SPECTRA**
The geoid spectrum from altimetry
[NASA-TM-79583] N78-31633
Optical difference frequency generation of far infrared radiation
N78-31895

**PRANDTL NUMBER**
Continuing crack tip deformation and fracture for plane-strain crack growth in elastic-plastic solids
[COO-3084-56] N78-31472

**PRECIPITATION (METEOROLOGY)**
Single and dual air curtain jets used as protection against precipitation
[UTIAS-227] N78-31269

**PRESSURE DISTRIBUTION**
Development of a computer program to calculate aerodynamic characteristics of bodies and wing-body combinations --- surface pressure distribution in supersonic flow
[AD-A055846] N78-31053
Investigations on unsteady pressure distribution measurements in rotating systems
[DLR-FB-77-43] N78-31135
Pressure distribution in an open cavity at linear increasing external pressure --- ventilation, vacuum chambers, space simulation chambers
[DLR-FB-77-53] N78-31400

**PRESSURE EFFECTS**
Effects of pressure anisotropy on the stability of the guiding center plasma
[ORO-5260-1] N78-31907

**PRESSURE ICE**
Segregation freezing as the cause of suction force for ice lens formation --- in soils
[AD-A055780] N78-31647

**PRESSURE MEASUREMENTS**
Correlation of combustor acoustic power levels inferred from internal fluctuating pressure measurements
[NASA-TM-78986] N78-31871

**PRESSURE SENSORS**
An evaluation of the fluidic oxygen partial pressure sensor
[AD-A055362] N78-31743

**PRESSURE VESSELS**
On bounds and approximate solutions for a problem in non-linear creep theory with applications to brittle damage
N78-31454

**PRESTRESSING**
Alternating tension-compression fatigue strength and property changes of steel after cold deformation at different deformation rates
[RAE-LIB-TRANS-1967] N78-31207

**PRINTED CIRCUITS**
IC fabrication using electron-beam technology
[AD-A055610] N78-31368

**PRIORITIES**
An M/M/1 dynamic priority queue with optional promotion
N78-31824

**PROBABILITY THEORY**
Probability intervals for the reliability of complex systems using Monte Carlo simulation
[PB-280191/8] N78-31449
Measures on the integers and limit distributions of additive, number-theoretic functions
N78-31848
MANOVA multiple comparisons associated with finite intersection tests
[AD-A055842] N78-31858

**PROBLEM SOLVING**
On the multiplicity of solutions of the inverse problem for a vibrating beam
[NASA-CR-157572] N78-31466
On the complexity of grammar and language problems
N78-31782
Truth maintenance systems for problem solving
[AD-A054826] N78-31799

**PROCESS CONTROL (INDUSTRY)**
Microcomputers. Part 4: Process control applications. Citations from the engineering index data base
[NTIS/PS-78/0616/9] N78-31779

**PROCUREMENT MANAGEMENT**
Simulation of the acquisition management information system
[AD-A055209] N78-31945

**PRODUCTION ENGINEERING**
Design and fabrication of a ring-stiffened graphite-epoxy corrugated cylindrical shell
[NASA-CR-3026] N78-31465

**PRODUCTION PLANNING**
Status of the Air Force's F-16 aircraft program
[PB-280304/7] N78-31946

**PROGRAM VERIFICATION (COMPUTERS)**
Model verification of large structural systems --- space shuttle model response
[NASA-CR-150811] N78-31464
Software tool (S) for evaluating the effects of finite wordlength
[AD-A053777] N78-31806
Validation of closed queueing network models for the DECsystem-10
[AD-A055118] N78-31830

**PROGRAMMING LANGUAGES**
On the complexity of grammar and language problems
N78-31782
A real-time language or small processors: Design, definition, and implementation
N78-31784
HOL code generator development methodology
[AD-A055383] N78-31804
Functional description of a validation tool for CMS-2 software
[AD-A055973] N78-31805
Maps: A matrix arithmetic programming system
[PB-279859/3] N78-31813
Large scale information systems, volume 1
[AD-A054942] N78-31950

**PROGRAMS**
US Navy fleet aviation training program development
[AD-A055788] N78-31734

**PROJECT MANAGEMENT**
Briefing on Department of Energy --- management of energy programs
[GPO-20-083] N78-31542

**PROJECT PLANNING**
LANDSAT policy issues still unresolved
[PB-279701/7] N78-31517

**PROJECTILES**
Three-beacon projectile guidance study
[AD-A055992] N78-31151

**PROPELLANT ACTUATED INSTRUMENTS**
A pressure limiting propellant actuating system
[NASA-CASE-MSC-18179-1] N78-31162

**PROPELLANT ADDITIVES**
Antimisting fuel spillage/airshear tests at Naval Weapons Center
[AD-A056113] N78-31256

**PROPELLANT CHEMISTRY**
Nitramine propellants --- gun propellant burning rate
[NASA-CASE-NPO-14103-1] N78-31255

**PROPELLANT STORAGE**
Propellant reassessment program
[AD-A055976] N78-31264

**PROPELLANTS**
Investigation of propellant and explosive solid solution systems II X-ray studies
[AD-A055981] N78-31263

**PROPELLERS**
Community noise exposure resulting from aircraft operations. Volume 5: Acoustic data on Air Force propeller aircraft
[AD-A055079] N78-31593

**PROTEINS**
The 70 S monosome accumulation and in vitro initiation complex formation by Escherichia coli ribosomes at 5 C
[NASA-CR-157591] N78-31691

**PROTON IRRADIATION**
Proton and electron irradiation of thermal control coatings and polymeric films. Part 1: Experimental part
[ESA-CR(P)-1077-VOL-1] N78-31252
Proton and electron irradiation of thermal control coatings and polymeric films. Part 2: Theoretical part
[ESA-CR(P)-1077-VOL-2] N78-31253

**PROTON-PROTON REACTIONS**
A search for charmed meson production in proton-proton collisions at the CERN-ISR
N78-31887

**PROTONS**
The reduction of molecular nitrogen, organic substrates and protons by vanadium(II)
N78-31181

**PROVING**
TRSB microwave landing system demonstration program at John F. Kennedy International Airport, Long Island, New York, USA
[AD-A055447] N78-31070
Functional description of a validation tool for CMS-2 software
[AD-A055973] N78-31805

**PSYCHOLOGICAL TESTS**
Estimation of the operating characteristics of the two-parameter beta method
[AD-A055611] N78-31860

**PUBLIC HEALTH**
Nitrosamines
[PB-280479/7] N78-31727
Federal noise research in noise effects
[PB-280335/1] N78-31733
Research needs relating to on-site Treatment of Domestic Wastes: Summary of Workshop
[PB-280989/5] N78-31966

**PULSARS**
Theory of the accretion column and cyclotron radiation in X ray pulsars
N78-31998

**PULSE COMPRESSION**
Signal Processing with a Reflective Dot Array (RDA)
N78-31285

**PURSUIT TRACKING**
Physiological measures of workloads: Correlations between physiological parameters and operational performance
N78-31753

**PYRIDINE NUCLEOTIDES**
The effect of high altitude on pyridine nucleotides and adenosine phosphates in the liver of the rat
N78-31689

**PYROLYSIS**
Conversion of trash to gasoline
[AD-A055113] N78-31257
Production method for hydrogen by thermomechanical decomposition of water
[LA-TR-77-52] N78-31265
Thermal and kinetic analysis of the pyrolysis of coals
[EPRI-AF-528] N78-31552

**PYROPHORIC MATERIALS**
Impact thresholds for the initiation of metal sparking
[AD-A054738] N78-31189


## Q


**QUADRATIC PROGRAMMING**
Basic optimal estimation and control problems in Hilbert space
[AD-A055614] N78-31864

**QUALIFICATIONS**
Evaluation and qualification of thick film hybrid microcircuits --- for space application
[ESA-SPEC-QRC-06-ISSUE-2-REV-1] N78-31376

**QUALITATIVE ANALYSIS**
Identification of wear particles, Part 1: preliminary investigations --- metal particles in lubricating oils
[AD-A055126] N78-31240

**QUALITY CONTROL**
Statistical review of counting accelerometer data for Navy and Marine fleet aircraft from 1 Jan. 1962 to 31 Dec. 1977
[AD-A055672] N78-31098
Qualification test for safety and arming device MSFC PN 10A00465 TM c/S PN 816780 for space shuttle solid rocket booster, volume 1
[NASA-CR-150791] N78-31159
Qualification test for safety and arming device MSFC PN 10A00465 TM c/S PN 816780 for space shuttle solid rocket booster, volume 1, section 2
[NASA-CR-150792] N78-31160
Qualification test for safety and arming device MSFC PN 10A00465 TM c/S PN 816780 for space shuttle solid rocket booster, volume 2
[NASA-CR-150793] N78-31161
Feasibility of using fluorescent materials in product assurance applications and for locating adhesive bond fractures
[AD-A055979] N78-31245

Development of plating thickness standards
[BDX-613-1709-REV] N78-31272
Teper technical evaluation program evaluation and restructuring
[AD-A055757] N78-31343
Quality assurance program document for 75 mW radioisotope thermoelectric generator program
[GA-A-14807] N78-31573
QUANTUM CHEMISTRY
Molecular orbital calculations on molecules of Air Force interest --- TNT decomposition and pyrolytic products in rocket exhausts
[AD-A055072] N78-31881
QUANTUM STATISTICS
Light on light: Satyendra Nath Bose's work on radiative equilibrium --- quantum statistics
[ORO-3992-307] N78-31942
QUANTUM THEORY
Quantum theory of cyclotron resonance lineshape for the inversion layer electrons in Metal-Oxide-Semiconductor [MOS]
N78-31925
QUARTZ
Temperature dependence of the dielectric constant of quartz polyimide, part 2
[AD-A055105] N78-31239
QUARTZ CRYSTALS
Quartz crystal microbalances: A refined technique for determining changes in mass loading from frequency shifts
[LA-7106-MS] N78-31936
QUENCHING [COOLING]
Heat transfer modeling and analytical quenching of a powder metallurgy turbine disk during heat treatment
[AD-A054022] N78-31110
QUEUEING THEORY
An M/M/1 dynamic priority queue with optional promotion
N78-31824
Validation of closed queueing network models for the DECsystem-10
[AD-A055118] N78-31830
Regenerative simulation of response times in networks of Queues II multiple job types
[AD-A055584] N78-31831

# R

RADAR
Systems applications of SAW filters and delay lines
N78-31294
The effect of polarization diversity on receiving systems
[AD-A055450] N78-31345
Multidomain algorithm evaluation, volume 1
[AD-A054357] N78-31826
Multidomain algorithm evaluation, volume 2
[AD-A054358] N78-31827
RADAR BEACONS
Three-beacon projectile guidance study
[AD-A055992] N78-31151
RADAR CROSS SECTIONS
Space-time signal processing of radar returns
[AD-A055758] N78-31342
RADAR EQUIPMENT
SAW filter application for phased array radar
N78-31300
RADAR IMAGERY
A CCD memory chip for radar image processing
N78-31307
Radar image modeling and processing for real-time RF simulation
[AD-A055060] N78-31333
RADAR RECEIVERS
Phase-locked tracking loops for LORAN-C
[NASA-CR-157582] N78-31068
The effect of polarization diversity on receiving systems
[AD-A055450] N78-31345
RADAR RECEPTION
The effect of polarization diversity on receiving systems
[AD-A055450] N78-31345
RADAR RESOLUTION
Operation of SAW reflective array pulse compressors in a high performance radar with minus 0.4 meter range resolution
N78-31315
RADAR SCANNING
Reading and acoustic processing of optical images
N78-31304
The steering problem for the mirror-scan tracking system. Part 1: The stop-go-stop procedure
[AD-A055125] N78-31336
RADAR TRACKING
The steering problem for the mirror-scan tracking system. Part 1: The stop-go-stop procedure
[AD-A055125] N78-31336
RADAR TRANSMISSION
Applications of piezoelectric convoluters to radar signal processing
N78-31314
CCD delay lines for the processing of a radar signal: Application to an MTI
N78-31317
A CCD delay line Doppler analyser
N78-31318
RADIANT COOLING
Radiative and gas cooling of falling molten drops
[NASA-TM-78189] N78-31381
RADIANT FLUX DENSITY
Measurements of 15.11-MeV gamma-ray flux produced in the reactions C-12[p, p']-C-12'[15.11 MeV] and O-16[p, p' alpha]-C-12'[15.11 MeV]
N78-32007
RADIATION ABSORPTION
Absorptance of IR laser radiation at a metallic interface at various angles of incidence and polarizations
[AD-A055256] N78-31418
RADIATION COUNTERS
The nuclear radiation monitor for the Spacelab/Shuttle
N78-32003
RADIATION DAMAGE
Radiation effects on MOS/SOS semiconductor devices --- defects in aluminum oxide crystals
[AD-A055925] N78-31934
Radiation damage of germanium detectors
N78-32002
RADIATION DETECTORS
A hard X-ray and gamma ray observation of the 22 November 1977 solar flare --- experimental design
N78-31974
Rice University observations of the galactic center
N78-31982
Gamma ray spectroscopy in astrophysics: Future role of scintillation detectors
N78-31999
Capabilities of germanium detectors --- gamma ray spectoscopy
N78-32000
Radiation damage of germanium detectors
N78-32002
RADIATION DOSAGE
Dependence of the reaction of the human nervous system on the distribution of absorbed doses of ionizing radiation
N78-31704
Late biological effects of ionizing radiation as influenced by dose, dose rate, age at exposure, and genetic sensitivity to neoplastic transformation
[LA-UR-78-681] N78-31724
Use of a metal-nitride-oxide-semiconductor as the detector for a radiation dosimeter
[AD-A055187] N78-31932
RADIATION EFFECTS
Radiation damage of laser materials. A bibliography with abstracts
[NTIS/PS-78/0516/1] N78-31424
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 40. Effects on nonionizing electromagnetic radiation
[JPRS-71595] N78-31705
RADIATION HAZARDS
Hazard analysis of broad-band optical sources
[AD-A054802] N78-31900
RADIATION MEASUREMENT
Gamma ray facilities at the University of Maryland cyclotron --- data acquisition and radiation measurement
N78-32008
RADIATION SHIELDING
Background of a shielded Ge[Li] spectrometer at balloon altitudes
N78-32001
RADIATION SOURCES
Nuclear gamma rays from compact objects --- nuclear interactions around neutron stars and black holes
N78-31984
RADIATIVE HEAT TRANSFER
Numerical procedure to determine geometric view factors for surfaces occluded by cylinders
[NASA-TM-78740] N78-31354
RADIATIVE RECOMBINATION
The laser lightning rod system: A feasibility study
[AD-A055255] N78-31417
RADIO ANTENNAS
Test and evaluation of air/ground communications antennas
[AD-A056148] N78-31325
RADIO COMMUNICATION
Evaluation of coherent FSK performance in atmospheric radio noise
[AD-A055237] N78-31330
RADIO FREQUENCY INTERFERENCE
A random point process model for atmospheric radio noises
[AD-A055123] N78-31326
Evaluation of coherent FSK performance in atmospheric radio noise
[AD-A055237] N78-31330
UHF scintillation characteristics as observed from Keflavik, Iceland
[AD-A055760] N78-31344
RADIO INTERFEROMETERS
Optical measurement of the radio interferometer of the DFVLR
[DLR-IB-551-77/13] N78-31901
RADIO RECEIVERS
Performance in a jamming environment of a low-cost GRS user receiver algorithm for aiding a tactical INS
[AD-A055239] N78-31078
Transient response of filters
[AD-A055324] N78-31366
RADIO RELAY SYSTEMS
Broadband modem II
[AD-A055269] N78-31334
RADIOACTIVE CONTAMINANTS
Least-squares resolution of gamma-ray spectra in environmental samples --- computer program for analyzing sodium iodide gamma spectra
[PB-280237/9] N78-31886
RADIOACTIVE WASTES
Disposal of radioactive iodine in space
[NASA-TP-1313] N78-31740
RADIOGRAPHY
Radiographic examination of T55 engine
[AD-A055108] N78-31113
Development of ultrasonic examination methods for austenitic stainless steel weld inspection
[HEDL-SA-1348] N78-31445
RADIOISOTOPE BATTERIES
Alternate power sources session: Nuclear battery hybrid configuration study
[AD-A055182] N78-31546
Quality assurance program document for 75 mW radioisotope thermoelectric generator program
[GA-A-14807] N78-31573
RADIOLOGY
ORIS: The Oak Ridge Imaging System program listings
[ORNL-TM-5875-V3] N78-31722
RADIOLYSIS
Radiolysis studies on reactive intermediates --- tunneling and diffusive recombination of solvated electrons
[COO-2086-88] N78-31200
RAMAN SPECTRA
Raman sidescatter instability in a nonuniform plasma --- laser fusion
N78-31902
RAMJET ENGINES
Flame stabilization in a ramjet combustion chamber by means of a pilot gas generator
[DLR-FB-77-54] N78-31117
The use of ram rockets for high altitude missiles
[DLR-FB-77-47] N78-31153
RANDOM ACCESS MEMORY
IC fabrication using electron-beam technology
[AD-A055610] N78-31368
RANDOM NOISE
A method for the exact determination of noise parameters of active twoports in the frequency range 1 GHz to 11 GHz
[RAE-LIB-TRANS-1963] N78-31877
RANDOM SAMPLING
Testing to determine the underlying distribution using randomly censored data
[AD-A054978] N78-31855
RANDOM SIGNALS
Review of methods for description of random transmission channels applications to identification and optimisation of detection and transmission processes
[CEPHAG-35/77] N78-31347
RANDOM VARIABLES
A random point process model for atmospheric radio noises
[AD-A055123] N78-31326
RANGE AND RANGE RATE TRACKING
Backus-Gilbert inversion of electromagnetic propagation phenomena for remote probing ρf the atmosphere
[DLR-IB-551-76/21] N78-31346
RANGE FINDERS
A design of trajectory estimator using multiple DME range measurements
[AD-A055191] N78-31077
RANGELANDS
Nationwide forestry applications program: Procedure 1 applicability to rangeland classification --- Weld County, Colorado
[E78-10202] N78-31500
RANK TESTS
A robust class of tests and estimates for multivariate location based on ranks
N78-31852
RANKING
An M/M/1 dynamic priority queue with optional promotion
N78-31824
RARE EARTH ALLOYS
Electron scattering rate anisotropy and conduction electron-4f moment interactions Au[rare earth] dilute alloys
N78-31920

**RARE GASES**
Compilation of data relevant to rare gas-rare gas and rare gas-monohalide excimer lasers, volume 1
[AD-A053827] N78-31414
Experimental studies of electron impact depopulation of excited states of atoms: Application to laser development for fusion and isotope separation
[COO-4199-1] N78-31884

**RATS**
The effect of high altitude on pyridine nucleotides and adenosine phosphates in the liver of the rat
N78-31689

**RAYLEIGH WAVES**
Elastophotoconductance in polycrystalline films of cadmium-sulfide
N78-31921

**REACTANCE**
Damper winding reactance
[AD-A055199] N78-31364

**REACTION KINETICS**
Radiolysis studies on reactive intermediates --- tunneling and diffusive recombination of solvated electrons
[COO-2086-88] N78-31200
Reaction-R constants and simple rate theories applied to the mercury-chloride laser
[AD-A055229] N78-31419
Reaction rate and photochemical data for atmospheric chemistry, 1977
[NASA-CR-157610] N78-31607
Reaction rate data, number 61
[AD-A055983] N78-31644
Molecular orbital calculations on molecules of Air Force interest --- TNT decomposition and pyrolytic products in rocket exhausts
[AD-A055072] N78-31881

**REACTION TIME**
Auditory communication and workload --- human response time measurements to voice communication
N78-31749

**REACTOR SAFETY**
Enhancing public acceptance of nuclear energy by improving reactor safety systems
[ORAE/IEA[R]-77-28] N78-31889
An acceptance nuclear fission future --- by assurances of nuclear reactor safety
[ORAU/IEA[M]-77-29] N78-31890
Toward an acceptable nuclear future --- by assurances of nuclear reactor safety
[ORAU/IEA[O]-77-31] N78-31892

**READING**
Reading and acoustic processing of optical images
N78-31304

**REAL TIME OPERATION**
A design of trajectory estimator using multiple DME range measurements
[AD-A055191] N78-31077
Investigation of real-time satellite-to-satellite tracking using extended Kalman filters
[AD-A055115] N78-31148
Real time digital sampler
[LA-TR-78-23] N78-31410
Retransmission of hydrometric data in Canada
[E78-10204] N78-31502
A real-time language or small processors: Design, definition, and implementation
N78-31784
On the dual-adaptive control and its practical applications
[CEPHAG-52/77] N78-31832

**RECEIVERS**
Walsh adaptive filter
[AD-A055170] N78-31328
Analysis of receiver mixers
[AD-A055283] N78-31362
A comparative study of optimum and suboptimum direct-detection laser ranging receivers
[NASA-TP-1315] N78-31413

**RECEPTORS [PHYSIOLOGY]**
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 35
[JPRS-71467] N78-31694
Electroreceptors in man and other animals
N78-31696

**RECOGNITION**
Some new results on image processing and recognition
[AD-A055862] N78-31807

**RECORDING INSTRUMENTS**
Spectral and total emissivity and reflectivity at high temperatures
[AD-A055027] N78-31191

**RECURSIVE FUNCTIONS**
A novel signal integrator using CCDs
N78-31316

**RECYCLING**
Cypress wetlands for water management, recycling and conservation
[PB-282159/3] N78-31970

**REDUNDANCY**
Statistical model for random errors of position location based on lines of position
[PB-281158/6] N78-31079
Backup control for a variable cycle engine --- fighter aircraft
[AD-A055658] N78-31116

**REFERENCE ATMOSPHERES**
A computer version of the US Standard Atmosphere, 1978
[NASA-CR-150778] N78-31632

**REFLECTED WAVES**
Brillouin scattering of reflected light by the bulk acoustic phonons in GaAs and CdS
N78-31923

**REFLECTORS**
Non-tracking solar energy collector system
[NASA-CASE-NPO-13813-1] N78-31526

**REFRACTIVITY**
Piezo-optic properties of liquids under high pressure --- interferometry of refractive index variations
N78-31898

**REGGE POLES**
Multiperipheral ring dynamics and a definition of the complete twisted Reggeon loop
[LBL-6199] N78-31938

**REGIONAL PLANNING**
LANDSAT [MSS]: Image demographic estimations
[E78-10183] N78-31482
A summary of the users perspective of LANDSAT-D and reference document of LANDSAT users
[E78-10208] N78-31506
Public participation in water resources planning: A case study and literature review
[PB-280968/9] N78-31524
Cost of solid waste management in northeast Illinois
[PB-280562/0] N78-31964
Research needs relating to on-site Treatment of Domestic Wastes: Summary of Workshop
[PB-280989/5] N78-31966

**REGRESSION ANALYSIS**
Computerized aircraft attrition program
[AD-A055784] N78-31094
Small sample robustness properties of generalized M-estimators applied to first order autoregression
N78-31853

**REGULATIONS**
Use and abuse of the regulatory process in a developing solar energy space conditioning industry
[PB-280165/2] N78-31588
Regulations and resource file of continuous monitoring information
[PB-280975/4] N78-31625
Research needs relating to on-site Treatment of Domestic Wastes: Summary of Workshop
[PB-280989/5] N78-31966

**REINFORCED PLASTICS**
Development and evaluation of elastomeric materials for geothermal applications
[JPL-PUB-78-69] N78-31237

**REINFORCEMENT RINGS**
Design and fabrication of a ring-stiffened graphite-epoxy corrugated cylindrical shell
[NASA-CR-3026] N78-31465

**REINFORCING FIBERS**
Fabrication of graphite-aluminum composites via pultrusion
[AD-A055257] N78-31173
TF30 third-stage composite fan blade service program
[AD-A055891] N78-31174
Development and evaluation of elastomeric materials for geothermal applications
[JPL-PUB-78-69] N78-31237

**RELATIVISTIC PARTICLES**
Integral formulation of Einstein's equations and Mach's principle
N78-31866

**RELATIVISTIC PLASMAS**
REB focusing in a high-voltage diode --- pulsed electron accelerators
[SAND-78-6005] N78-31883

**RELATIVISTIC THEORY**
The dynamic theory, a new view of space, time, and matter
[AD-A055325] N78-31941

**RELIABILITY**
Reliability in the design of welded structures
N78-31438

**RELIABILITY ANALYSIS**
Multistate reliability models: A survey
[AD-A055111] N78-31446
Analyzing availability and readiness using transfer function models and cross spectral analysis
[AD-A055724] N78-31447
Probability intervals for the reliability of complex systems using Monte Carlo simulation
[PB-280191/8] N78-31449

**REMOTE HANDLING**
A comparison of control modes for time delayed remote manipulation
N78-31737

**REMOTE SENSORS**
A CCD digital image store
N78-31306
High altitude perspective --- cost-reimbursable services using NASA U-2 aircraft
[NASA-SP-427] N78-31508
An evaluation of the first four LANDSAT-D thematic mapper reflective sensors for monitoring vegetation: A comparison with other satellite sensor systems
[NASA-TM-79617] N78-31510
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 1 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157600] N78-31511
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 2 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157601] N78-31512
Application of heat-flow temperature model for remotely assessing near surface soil moisture by thermography
[PB-279616/7] N78-31518

**REQUIREMENTS**
Configuration management requirements --- for ESA spacecraft and associated equipment development
[ESA-SPEC-QRA-03-ISSUE-3] N78-31157
Report of the 1977 National Survey of science, mathematics, and social studies education
[PB-280192/6] N78-31944

**RESCUE OPERATIONS**
Search and rescue methods and equipment. A bibliography with abstracts
[NTIS/PS-78/0539/3] N78-31066

**RESEARCH AIRCRAFT**
Aerodynamic characteristics of a hypersonic research airplane concept having a 70 deg swept double-delta wing at Mach number 0.2
[NASA-TP-1252] N78-31045

**RESEARCH AND DEVELOPMENT**
Future needs and opportunities in the air traffic control system
[GPO-98-931] N78-31076
Catalog of water resources research in Illinois
[PB-280561/2] N78-31523
Environmental challenges of the President's energy plan: Implications for research and development
[GPO-96-834] N78-31543

**RESEARCH FACILITIES**
INPE LANDSAT system
[E78-10180] N78-31479

**RESERVOIRS**
Computer processing of LANDSAT digital data and sensor interface development for use in New England reservoir management
[AD-A055762] N78-31513
Problems associated with maintenance of channel capacity below federal reservoirs in Kansas
[PB-280560/4] N78-31522

**RESIDENTIAL AREAS**
LANDSAT [MSS]: Image demographic estimations
[E78-10183] N78-31482
Greenbelt Community Project: Solar energy retrofit for a multi-family dwelling
[NASA-TM-79612] N78-31539
Continuation study of the potential for solar heating of buildings in Canada
[NP-23162] N78-31583

**RESIDUAL STRESS**
Evaluation of built-in stresses during manufacture of elements made of carbon fiber reinforced plastics
[ESA-CR[P]-1058] N78-31179

**RESINS**
Distribution of naphthalene between commercial resins and water-methanol solutions
[IS-T-802] N78-31193
A literature review: Problem definition studies on selected toxic chemicals. Volume 6: Occupational health and safety and environmental aspects of urea-formaldehyde resins
[AD-A054991] N78-31716

**RESONANCE SCATTERING**
Resonant scattering of electromagnetic radiation from non-spherical optically anisotropic targets with axial symmetry
N78-31322

**RESONANT FREQUENCIES**
An improved computational procedure for determining helicopter rotor blade natural modes
[NASA-TM-78670] N78-31792
Optical rotary saturation --- double resonance interaction
N78-31896
Resonance oscillations near the lower hybrid frequency in a bounded plasma in a strong magnetic field
N78-31904

**RESONATORS**
Design and performance of SAW-resonators and resonator-filters
N78-31293

**RESOURCE ALLOCATION**
Preliminary findings and views concerning the exemption of aviation gasoline from the mandatory petroleum allocation and price regulations
[DOE/ERA-0001] N78-31957

Preliminary findings and views concerning the exemption of kerojet fuels from the mandatory petroleum allocation and price regulations
[DOE/ERA-0002] N78-31958
**RESOURCES MANAGEMENT**
A demonstration of areawide water resources planning --- district of columbia
[PB-280750/1] N78-31521
Public participation in water resources planning: A case study and literature review
[PB-280968/9] N78-31524
Massachusetts coastal zone management program and final environmental impact statement N78-31681
**RESPIRATORY PHYSIOLOGY**
Physiological response to atmospheric pollutants
[PB-280413/6] N78-31731
**RESPIRATORY RATE**
Use of Inspiratory Minute Volumes in evaluation of rotary and fixed wing pilot workload --- respiratory response to flight conditions N78-31754
**RESPIRATORY SYSTEM**
Factors determining maximal expiratory flows in the human lung N78-31711
**RESPONSE TIME (COMPUTERS)**
Regenerative simulation of response times in networks of Queues II multiple job types
[AD-A055584] N78-31831
**REYNOLDS NUMBER**
An acoustic field generated by subsonic jets at low Reynolds numbers N78-31870
**RHENIUM COMPOUNDS**
Magnetic susceptibility of AnRe2 compounds
[CONF-771127-15] N78-31195
**RICE**
AGRESTE project: Agricultural resources investigations in northern Italy and southern France
[E78-10199] N78-31497
**RIDING QUALITY**
Vibration aspects of ride quality modeling for the DOT PTACV: Theory and experiment
[PB-279846/0] N78-31744
**RIGID STRUCTURES**
Development of a set of general rigid and flexible body equations of motion in coupled form using the direct approach N78-31867
**RINGS (MATHEMATICS)**
Multiperipheral ring dynamics and a definition of the complete twisted Reggeon loop
[LBL-6199] N78-31938
**RISK**
A study of analog programming for prediction of crack growth in aircraft structures subjected to random loads
[AD-A055789] N78-31097
Risk analysis in environmental studies. 1: Risk analysis methodology, a statistical approach. 2: Data management for environmental studies
[RHO-SA-33] N78-31597
Decision making in management. A bibliography with abstracts
[NTIS/PS-78/0605/2] N78-31947
**RIVERS**
Bearing capacity of river ice for vehicles
[AD-A055244] N78-31637
**ROADS**
Pavement design manual for secondary roads in North Carolina
[PB-280971/3] N78-31275
**ROCKET ENGINES**
Hot gas side heat transfer coefficients in high energy rocket engines with thrust variation
[DLR-FB-77-42] N78-31165
**ROCKET EXHAUST**
Ground impingement of a fan jet exhaust plume
[AD-A054832] N78-31112
**ROCKS**
Hot dry rock, an alternate geothermal energy resource: A challenge for instrumentation
[LA-UR-78-707] N78-31553
**RODS**
A survey of properties of latched non-reciprocal ferrite phase shifters with cylindrical rods at 3, 5.5, 9.3, and 16 GHz
[PHL-1977-39] N78-31373
**ROLLER BEARINGS**
Rolling element fatigue testing of gear materials
[NASA-CR-135411] N78-31427
**ROTARY WINGS**
The transonic flow on a helicopter rotor N78-31042
Antitorque training: Evaluation of effectiveness in reducing mishap losses
[AD-A055040] N78-31092
Demonstration of the microwave ice protection concept
[AD-A055824] N78-31096
**ROTATING BODIES**
Investigations on unsteady pressure distribution measurements in rotating systems
[DLR-FB-77-43] N78-31135
**ROTATING DISKS**
Deflection of a transversely loaded spinning disk N78-31455
**ROTOR AERODYNAMICS**
Turbine engine rotordynamic evaluation, volume 1
[AD-A055262] N78-31111
Giromill wind tunnel test and analysis. Volume 1: Executive summary
[COO-2617-4/1-VOL-1] N78-31579
**ROTOR BLADES**
Demonstration of the microwave ice protection concept
[AD-A055824] N78-31096
An improved computational procedure for determining helicopter rotor blade natural modes
[NASA-TM-78670] N78-31792
**ROTOR BLADES (TURBOMACHINERY)**
Advanced optical blade tip clearance measurement system
[NASA-CR-159402] N78-31106
**RUBBER**
Solar energy systems. Standards for rubber seals
[PB-280114/0] N78-31444
**RUNWAYS**
Analysis of runway occupancy times at major airports
[AD-A056052] N78-31131
**RURAL AREAS**
Research needs relating to on-site Treatment of Domestic Wastes: Summary of Workshop
[PB-280989/5] N78-31966
**RYDBERG SERIES**
Nonlinear spectroscopy
[AD-A055076] N78-31186

## S

**S MATRIX THEORY**
Multiperipheral ring dynamics and a definition of the complete twisted Reggeon loop
[LBL-6199] N78-31938
**S-3 AIRCRAFT**
Program analyses for the S-3 weapon system improvement program
[AD-A055887] N78-31093
**SAFETY DEVICES**
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 1
[NASA-CR-150791] N78-31159
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 1, section 2
[NASA-CR-150792] N78-31160
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 2
[NASA-CR-150793] N78-31161
**SAFETY FACTORS**
Safety analysis LOX-30 liquid oxygen generator
[AD-A054804] N78-31063
Determination of minimum non-propagation distance of aluminum buckets containing 15 pounds of composition A5 --- handling high explosives
[AD-A054737] N78-31259
Critical depth tests of bulk TNT flake explosive --- conveyors for handling explosives safely
[AD-A054739] N78-31260
Research safety vehicle. Phase 2, volume 2: Comprehensive technical results
[PB-280153/8] N78-31441
Research safety vehicle. Phase 2, volume 3A: Subcontractor reports: The Budd Company, Man Factors, Inc., Mard Analysis Corporation, Monsanto Research Corporation
[PB-280154/6] N78-31442
Research safety vehicle. Phase 2, volume 3B: Subcontractor reports. RCA Laboratories, Stanford Research Institute, System Technology, Inc., University of Utah
[PB-280155/3] N78-31443
**SALINITY**
Application of heat-flow temperature model for remotely assessing near surface soil moisture by thermography
[PB-279616/7] N78-31518
**SAMPLERS**
Real time digital sampler
[LA-TR-78-23] N78-31410
**SAMPLES**
Effect of handling procedures on sample quality --- organic compounds
[PB-279910/4] N78-31204
**SAMPLING**
Improved temperature stability of sulfur dioxide samples collected by the federal reference method
[PB-279873/4] N78-31610
A study of weighted distributions and size-biased sampling N78-31847
A computer program for fitting censored samples to a Weibull distribution [CENWEIR]
[AD-A054833] N78-31856
Bias in the estimates of treatment effects in quasi-experimental evaluations
[PB-280060/5] N78-31861
**SANDSTONES**
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 1 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157600] N78-31511
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 2 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157601] N78-31512
**SANDWICH STRUCTURES**
Evaluation of built-in stresses during manufacture of elements made of carbon fiber reinforced plastics
[ESA-CR(P)-1058] N78-31179
**SANITATION**
Research needs relating to on-site Treatment of Domestic Wastes: Summary of Workshop
[PB-280989/5] N78-31966
**SATELLITE ATTITUDE CONTROL**
Study of attitude control systems using the earth's magnetic field at synchronous altitudes
[ESS/SS-834] N78-31154
**SATELLITE INSTRUMENTS**
The geoid spectrum from altimetry
[NASA-TM-79583] N78-31633
**SATELLITE OBSERVATION**
The coverage field of earth observation satellites at the earth surface. Description of the computer program COFI
[DLR-IB-552-77/40] N78-31516
The utility of surface magnetic field measurements in the MAGSAT program
[NASA-TM-79614] N78-31635
World Weather Watch. The role of satellites in WMO programmes in the 1980s
[WMO-494] N78-31676
**SATELLITE ORBITS**
M2 ocean tide parameters and the deceleration of the moon's mean longitude from satellite orbit data
[NASA-TM-79571] N78-32028
**SATELLITE POWER TRANSMISSION (TO EARTH)**
Microwave electric power transmission. A bibliography with abstracts
[NTIS/PS-78/0580/7] N78-31379
**SATELLITE ROTATION**
Satellite optical tracking: Spin decay and flash observations N78-32019
**SATELLITE TRACKING**
A generalized Monte Carlo analysis program for Kalman filter design with application to an aircraft-to-satellite tracking filter
[AD-A055189] N78-31156
Backus-Gilbert inversion of electromagnetic propagation phenomena for remote probing of the atmosphere
[DLR-IB-551-76/21] N78-31346
Optical measurement of the radio interferometer of the DFVLR
[DLR-IB-551-77/13] N78-31901
**SATELLITE TRANSMISSION**
The 20/30 GHz satellite systems technology needs assessment
[NASA-TM-78975] N78-31323
The design and demonstration of an advanced data collection/position locating system, addendum --- coherent demodulator
[NASA-CR-156813] N78-31819
**SATELLITE-BORNE INSTRUMENTS**
A hard X-ray and gamma ray observation of the 22 November 1977 solar flare --- experimental design N78-31974
The ISEE-C gamma ray burst spectrometer N78-32009
High resolution spectroscopy from low altitude satellites --- gamma ray astronomy N78-32010
HEAO C-1 gamma-ray spectrometer --- experimental design N78-32011
The gamma ray observatory N78-32013
**SATELLITE-TO-SATELLITE TRACKING**
Investigation of real-time satellite-to-satellite tracking using extended Kalman filters
[AD-A055115] N78-31148
**SATURATION**
New approximation equations for the saturation pressure of water vapor and for humidity parameters used in meteorology
[DLR-FB-77-52] N78-31679
**SCALE (RATIO)**
Reevaluation of Modified Mercalli Intensity Scale for earthquakes using distance as determinant
[PB-281459/8] N78-31657
**SCALE MODELS**
Contamination flashover mechanisms of dc transmission line insulators
[HCP/T2068-1] N78-31372

**SCANNERS**
TRSB microwave landing system demonstration program at Kristiansand, Norway
[AD-A055317] N78-31071
TRSB microwave landing system demonstration program at Charleroi, Belgium
[AD-A055920] N78-31072
A Monte Carlo analysis of science instrument scan sequences for unmanned missions to the planets
N78-31136

**SCATTERING CROSS SECTIONS**
A search for charmed meson production in proton-proton collisions at the CERN-ISR
N78-31887
Cross sections relevant to gamma ray astronomy
N78-32006

**SCATTEROMETERS**
Search for broad gamma ray lines with the UCR double Compton scatter telescope
N78-31981

**SCHEDULING**
Analysis of runway occupancy times at major airports
[AD-A056052] N78-31131

**SCHOOLS**
Report of the 1977 National Survey of science, mathematics, and social studies education
[PB-280192/6] N78-31944

**SCHOTTKY DIODES**
Experiments and analysis of acoustoelectric memory correlators
N78-31296
Contact whiskers for millimeter wave diodes
[NASA-TM-79616] N78-31355

**SCIENCE**
International scientific activities at selected institutions, 1975-1976 and 1976-1977
[PB-280151/2] N78-31943
Report of the 1977 National Survey of science, mathematics, and social studies education
[PB-280192/6] N78-31944

**SCINTILLATION COUNTERS**
Two FORTRAN programs for calculating global ionospheric amplitude and phase scintillation
[AD-A055273] N78-31641
Gamma ray spectroscopy in astrophysics: Future role of scintillation detectors
N78-31999

**SCRUBBERS**
Flue gas desulfurization systems: Design and operating considerations. Volume 1: Executive summary
[PB-280253/6] N78-31598
Flue gas desulfurization systems: Design and operating considerations. Volume 2: Technical report
[PB-280254/4] N78-31599
Cleaning coal with coal: Coal humic acids for removal of acids, alkali, salinity, and heavy metal pollutants associated with the use of coal as a fuel
[PB-280580/2] N78-31608

**SEA WATER**
Sedimentary geochemistry of carbonate-silicate cyclic sedimentation in deep sea
N78-31477
Energy-quality calculations for freshwater chemical potential
N78-31566
Work Capability and physiological effects Predictive studies. 4: in HE-02 excursions to pressures of 400-800-1200- and 1600 feet of sea water
[NASA-CR-157571] N78-31714

**SEALS [STOPPERS]**
Gas path seal
[NASA-CASE-LEW-12131-2] N78-31103
Advanced ceramic material for high temperature turbine tip seals
[NASA-CR-135319] N78-31238

**SEARCH PROFILES**
Computer identification of infrared spectra by correlation-based file searching
[AD-A055277] N78-31770

**SECONDARY EMISSION**
Thermodynamic interpretation of secondary ion and photon emission during sputtering of silicon
N78-31912

**SECONDARY FLOW**
Secondary flow vorticity in the passage of a rotor
[AD-A055388] N78-31391

**SECURITY**
Computer program specification for security kernel for PDP-11/45, volume I
[AD-A054247] N78-31764

**SEDIMENTARY ROCKS**
Sedimentary geochemistry of carbonate-silicate cyclic sedimentation in deep sea
N78-31477
Regional investigations of tectonic and igneous geology, Iran, Pakistan, and Turkey
[E78-10197] N78-31495

**SEDIMENTS**
A study of the geochemistry of pelagic sediments: The interaction of trace metals and magnetic minerals with sedimentary environments
N78-31631

**SEISMIC WAVES**
Method for obtaining confidence-limit values for seismic values calculated from Vibroseis data
[USGS-474-255] N78-31651
The capability of a network of seismological stations to detect events and to obtain identification parameters
[FOA-C-20231-T1] N78-31654
Seismic magnitude estimates, with a minimum number of detections
[FOA-C-20232-T1] N78-31655

**SEISMOGRAPHS**
The capability of a network of seismological stations to detect events and to obtain identification parameters
[FOA-C-20231-T1] N78-31654
Seismic magnitude estimates, with a minimum number of detections
[FOA-C-20232-T1] N78-31655

**SELENIUM**
Forbidden transition selenium atom photodissociation lasers
[UCRL-80490] N78-31422
Incapsulation and annealing of ion implanted selenium in GaAs
N78-31919

**SELF CONSISTENT FIELDS**
Magnetic interactions in the hubbard model
N78-31922

**SELF EXCITATION**
Flow-induced gate vibrations: Prevention of self-excitation. Computation of dynamic gate behaviour and the use of models
[PUBL-164] N78-31396

**SELF ORGANIZING SYSTEMS**
Investigations of self organizing control laws and possibilities of their realization
[DLR-FB-77-57] N78-31833

**SEMANTICS**
On the epistemological status of semantic networks
[AD-A055048] N78-31337
A formal approach to discourse anaphora
[AD-A055671] N78-31810

**SEMICONDUCTING FILMS**
Elastophotoconductance in polycrystalline films of cadmium-sulfide
N78-31921

**SEMICONDUCTOR DEVICES**
The monolithic integration of surface acoustic wave and semiconductor circuit elements on silicon for matched filter device development
N78-31295
Design of a microprocessor based system for testing of the NCR 2051 MNOS memory
[AD-A055200] N78-31767
Electrical traps in microwave materials
[AD-A055086] N78-31928

**SEMICONDUCTOR LASERS**
Use of a semiconductor laser in infrared spectroscopy --- air pollution monitoring
[IS-T-786] N78-31196

**SEMICONDUCTORS [MATERIALS]**
Elastic properties of one-dimensional conductors and semiconductors
N78-31913
Electrical profiling of magnesium implanted gallium phosphide
[AD-A055195] N78-31929

**SEQUENTIAL ANALYSIS**
A Monte Carlo analysis of science instrument scan sequences for unmanned missions to the planets
N78-31136

**SERVICE LIFE**
Computerized aircraft attrition program
[AD-A055784] N78-31094
Design and development of a gas controlled heat pipe radiator for communication spacecraft application. Life test report
[ESA-CR[P]-1082] N78-31399

**SERVOCONTROL**
A comparison of control modes for time delayed remote manipulation
N78-31737

**SERVOMECHANISMS**
Actuator mechanism
[NASA-CASE-GSC-11883-2] N78-31426
Calibration and positional determination of Boller and Chivens 31-inch telescope B
[AD-A055266] N78-32020

**SET THEORY**
A new class of feasible direction methods
[AD-A055032] N78-31803

**SEWAGE TREATMENT**
Research needs relating to on-site Treatment of Domestic Wastes: Summary of Workshop
[PB-280989/5] N78-31966
Secondary treatment of municipal wastewater in the St. Louis Area - minimal impact expected
[PB-280965/5] N78-31969

**SHAFTS [MACHINE ELEMENTS]**
Evaluation of Amper journal bearings for ISEE-B boom hinge
[ESA-ESTL-29] N78-31439

**SHALE OIL**
The relative costs of producing syncrude from oil shales of various grades under varying conditions
[ERG-022] N78-31268
Comparison of energy analysis of oil shale
N78-31563

**SHALES**
Energy analysis and oil shale reserves
[ERG-023] N78-31584

**SHARP LEADING EDGES**
Diffraction effects of baffles on acoustic directivity patterns
N78-31869

**SHEAR STRENGTH**
Longitudinal shear behavior of several oxide dispersion strengthened alloys
[NASA-TM-78973] N78-31211

**SHEAR STRESS**
Engineering and pedological properties of soils as they affect soil erodibility
[PB-279856/9] N78-31658

**SHIFT REGISTERS**
CCD delay lines for the processing of a radar signal: Application to an MTI
N78-31317

**SHIPS**
A new method for solving surface-piercing-strut problems
[AD-A055078] N78-31270
Off design performance of supercharged two stroke diesel engines
N78-31437

**SHOCK LOADS**
High-temperature shock initiation of explosives
[LA-7158] N78-31267

**SIGNAL ANALYSIS**
Interactive signal analysis and ultrasonic data collection system user's manual
[NASA-CR-150798] N78-31763

**SIGNAL DETECTION**
Optimum quantization for memoryless detection in M-dependent noise
[AD-A055174] N78-31768

**SIGNAL DETECTORS**
Phase-locked tracking loops for LORAN-C
[NASA-CR-157582] N78-31068

**SIGNAL PROCESSING**
Impact of charge coupled devices and Surface Acoustic Wave Devices on Signal Processing and Imagery in Advanced Systems --- Conferences
[AGARD-CP-230] N78-31279
State-of-the-art of CCD and SAW technologies
N78-31280
The roles for CCD and SAW in signal processing
N78-31281
Signal Processing with a Reflective Dot Array [RDA]
N78-31285
The design and development of CCD programmable transversal filters and correlators
N78-31289
A hybrid SAW/CCD signal processor
N78-31290
A microprocessor controlled electrically programmable transversal filter
N78-31292
Convolution and correlation memory by means of surface acoustic wave devices
N78-31297
LSI video compression and computational modules utilizing digital charge coupled devices
N78-31298
Charge coupled devices with simplified drive requirements
N78-31299
IRCCD imaging sensors: A review of device options
N78-31302
CCPD: The optimum solid-state line scanner
N78-31303
Applications of a charge coupled device sensor for Nap-of-the-Earth helicopter operations
N78-31305
A CCD memory chip for radar image processing
N78-31307
Electro-optical processing of signals and images
N78-31308
A high performance CCD Linear Imaging Array
N78-31310
Development and application of a SAW Chirp-Z transformer
N78-31311
Spectral analysis using the CCD Chirp Z-transform
N78-31313
Applications of piezoelectric convoluters to radar signal processing
N78-31314
A novel signal integrator using CCDs
N78-31316
CCD delay lines for the processing of a radar signal: Application to an MTI
N78-31317
A CCD delay line Doppler analyser
N78-31318

Combined acquisition and fine synchronization system for spread spectrum receivers using a tapped delay line correlator
N78-31319
An algorithm for determining speech intelligibility
[AD-A055236] N78-31329
Space-time signal processing of radar returns
[AD-A055758] N78-31342
Resolution space, networks, and non-self-adjoint spectral theory II
[AD-A055613] N78-31865
SIGNAL RECEPTION
A theoretical and experimental study of Josephson frequency mixers for heterodyne reception in the submillimetre wavelength range
[ESA-CR[P]-1063] N78-31348
SIGNAL REFLECTION
Reflex feed system for dual frequency antenna with frequency cutoff means
[NASA-CASE-NPO-14022-1] N78-31321
SIGNAL TO NOISE RATIOS
Walsh adaptive filter
[AD-A055170] N78-31328
An algorithm for determining speech intelligibility
[AD-A055236] N78-31329
UHF adaptive array development program
[AD-A055942] N78-31339
Link analysis program LINKAN. Volume 1: Theoretical and programmer's manual --- satellite communication links
[ESA-CR[P]-1083-VOL-1] N78-31350
The influence of background noise level and signal duration on the judged annoyance of aircraft noise
[UTIAS-228] N78-31875
SILICON
Activated gas reactions with silicone and epoxy resins
[SAND-77-1429C] N78-31201
Performance limitations of two phase CCD's
N78-31288
The monolithic integration of surface acoustic wave and semiconductor circuit elements on silicon for matched filter device development
N78-31295
Thermodynamic interpretation of secondary ion and photon emission during sputtering of silicon
N78-31912
Electron spectroscopy and low-energy electron diffraction studies of silicon and titanium oxide surfaces
N78-31915
Electron tunneling into the A15 superconductors: Nb3Sn, V3Si, and Nb3Ge
N78-31924
Studies of indium-doped silicon
[AD-A054479] N78-31927
SILICON CARBIDES
Preliminary evaluation of tubular ceramic heat exchanger materials
[TID-28279] N78-31393
SILICON NITRIDES
RF plasma enhanced vapor deposition and etching of silicon nitride
[SAND-77-2070] N78-31176
Structure of gain boundaries in silicon nitride based alloys --- electron microscopy of MgO, Y2O3, and magnesium-sialon
[LBL-6985] N78-31177
Effect of attrition milling on the reaction sintering of silicon nitride
[NASA-TM-78965] N78-31236
SIMULATION
Radar image modeling and processing for real-time RF simulation
[AD-A055060] N78-31333
SINGLE CRYSTALS
Research on aluminum nitride materials
[AD-A054980] N78-31930
Domain orientation in single crystal TbFe[2] and Tb[.27]Dy[.73]Fe[2]
[AD-A055025] N78-31931
SINTERING
Effect of attrition milling on the reaction sintering of silicon nitride
[NASA-TM-78965] N78-31236
SKYLAB PROGRAM
The skylab S191 spectrometer experiment: Analysis of data and their applications to the earth sciences
[NASA-TM-58208] N78-31509
SLABS
Transient behavior of solid sensible heat thermal energy storage units
N78-31528
SLEEP
Instruments and methodology for the assessment of physiological cost of performance of stressful continuous operations: The air traffic services tower environment
N78-31752
SLIDING CONTACT
Thermomechanical effects in sliding wear
[AD-A055318] N78-31431
SLIDING FRICTION
Thermomechanical effects in sliding wear
[AD-A055318] N78-31431
SLOTS
Investigations of a highly loaded compressor cascade with a control of the blade boundary layer. Part 5: Experimental investigations on the cascade with slotted blades
[DLR-IB-151-77/14] N78-31056
SLUDGE
Pilot investigation of secondary sludge dewatering alternatives
[PB-280982/0] N78-31967
SLURRY PROPELLANTS
Development of an explosive slurry monitor
[AD-A054736] N78-31258
SNOW
The compression of wet snow
[AD-A055246] N78-31639
SOCIAL FACTORS
Social opportunity cost of capital: Empirical estimates
[ANL-SPG-2] N78-31955
SOCIOLOGY
Report of the 1977 National Survey of science, mathematics, and social studies education
[PB-280192/6] N78-31944
SODIUM CHLORIDES
The effect of fuel-to-air ratio on burner-rig hot corrosion
[NASA-TM-78960] N78-31210
SODIUM SULFATES
Inhibition of hot salt corrosion by metallic additives
[NASA-TM-78966] N78-31208
SOIL EROSION
Engineering and pedological properties of soils as they affect soil erodibility
[PB-279856/9] N78-31658
SOIL MECHANICS
Comparison of soil moduli obtained from nondestruction dynamic testing and constitutive equations
[AD-A055670] N78-31649
Engineering and pedological properties of soils as they affect soil erodibility
[PB-279856/9] N78-31658
SOIL MOISTURE
Application of heat-flow temperature model for remotely assessing near surface soil moisture by thermography
[PB-279616/7] N78-31518
Fundamental stochastic models of the transport of water and solutes through saturated and unsaturated porous media
[PB-279772/8] N78-31519
SOIL SCIENCE
Segregation freezing as the cause of suction force for ice lens formation --- in soils
[AD-A055780] N78-31647
SOILS
INPE's crop survey program using combined LANDSAT and aircraft data
[E78-10184] N78-31483
Use of LANDSAT imagery for soil survey
[E78-10189] N78-31488
Atlas of selected crop spectra, Imperial Valley, California
[E78-10201] N78-31499
Energy analysis and models of soil formation
N78-31564
SOLAR ARRAYS
Additional thermal cycling tests on solar cell panel samples under vacuum conditions
[DLR-IB-353-78/1] N78-31585
SOLAR CELLS
Measurements of material properties for solar cells -- aluminum film and KAPTON
[NASA-CR-150797] N78-31531
High output solar cell with multilayer AR coating
[AD-A054226] N78-31545
Additional thermal cycling tests on solar cell panel samples under vacuum conditions
[DLR-IB-353-78/1] N78-31585
SOLAR COLLECTORS
Solar energy systems. Standards for rubber seals
[PB-280114/0] N78-31444
Non-tracking solar energy collector system
[NASA-CASE-NPO-13813-1] N78-31526
Design and installation package for the Sunmat Flat Plate solar collector
[NASA-CR-150741] N78-31536
Double-exposure collector system
[TID-28291] N78-31576
SOLAR COOLING
Solar heating and cooling systems design and development --- prototype development
[NASA-CR-150770] N78-31532
SOLAR CORONA
Resonant absorption of Alfvenic surface waves and the heating of solar coronal loops
N78-32030
SOLAR ENERGY
Greenbelt Community Project: Solar energy retrofit for a multi-family dwelling
[NASA-TM-79612] N78-31539
Thermal stratification enhancement for solar energy applications
[AD-A055918] N78-31547
Energy analysis and models of soil formation
N78-31564
Energy analysis of Brazil
N78-31572
State-of-the-art reviews and bibliographies on energy. A bibliography with abstracts
[NTIS/PS-78/0586/4] N78-31586
Use and abuse of the regulatory process in a developing solar energy space conditioning industry
[PB-280165/2] N78-31588
SOLAR ENERGY ABSORBERS
Form-stable crystalline polymer pellets for thermal energy storage, phase 1
[ORO-5159-10] N78-31582
SOLAR ENERGY CONVERSION
Solar central receiver power plants
[SAND-77-8510] N78-31550
Energy analysis and model of intermediate agriculture
N78-31571
Solar Pilot Plant, phase 1: Preliminary design report. Volume 7: Pilot plant cost, commercial plant cost and performance, CDRL item 2
[SAN-1109-8/9-VOL-7] N78-31574
SOLAR FLARES
A hard X-ray and gamma ray observation of the 22 November 1977 solar flare --- experimental design
N78-31974
Gamma ray emission and solar flares
N78-31975
Solar gamma rays above 8 MeV
[NASA-TM-79623] N78-32031
SOLAR FLUX
Measurement of 200-400 nm solar UV fluxes at altitudes up to 39 km on the Stratcom 7-A balloon flight
[AD-A055774] N78-32033
SOLAR GENERATORS
Design, fabrication and testing of a CFA for use in the solar power satellite
[NASA-CR-159410] N78-31143
SOLAR HEATING
Solar heating and cooling systems design and development --- prototype development
[NASA-CR-150770] N78-31532
Solar Control design package
[NASA-CR-150771] N78-31535
Design data brochure: Solar hot water system
[NASA-CR-150699] N78-31538
JPL Energy Consumption Program [ECP] documentation: A computer model simulating, heating, cooling and energy loads in buildings --- low cost solar array efficiency
[NASA-CR-157599] N78-31541
Some aspects of energy use in housing
N78-31570
Continuation study of the potential for solar heating of buildings in Canada
[NP-23162] N78-31583
Use and abuse of the regulatory process in a developing solar energy space conditioning industry
[PB-280165/2] N78-31588
SOLAR MAXIMUM MISSION
Gamma ray spectroscopy in astrophysics: Solar gamma ray astronomy on solar maximum mission --- experimental design
N78-32012
SOLAR PONDS [HEAT STORAGE]
Solar pond
[NASA-CASE-NPO-13581-2] N78-31525
SOLAR PROBES
The energetic particle environment of the solar probe mission: As estimated by the participants of the Solar Probe Environment Workshop
[NASA-CR-157595] N78-32032
SOLAR RADIATION
Design definition study of the Earth radiation budget satellite system
[NASA-CR-158934] N78-31140
Gamma ray emission and solar flares
N78-31975
The energetic particle environment of the solar probe mission: As estimated by the participants of the Solar Probe Environment Workshop
[NASA-CR-157595] N78-32032
SOLAR REFLECTORS
Development of solar reflector material with good electrical conductivity. Volume 1: Phase 1 study
[ESA-CR[P]-1069] N78-31180
SOLAR SPECTROMETERS
Gamma ray spectroscopy in astrophysics: Solar gamma ray astronomy on solar maximum mission --- experimental design
N78-32012
SOLDERS
Reproducible adhesion test for soldered thick-film conductors
[AD-A054971] N78-31361
SOLID LUBRICANTS
Synergistic mechanisms of solid lubricants
[AD-A054741] N78-31243
SOLID SOLUTIONS
Investigation of propellant and explosive solid solution systems II X-ray studies
[AD-A055981] N78-31263

**SOLID WASTES**
Operation Breakthrough site management systems and pneumatic trash collection, executive summary
[PB-280143/9] N78-31962
Cost of solid waste management in northeast Illinois
[PB-280562/0] N78-31964
Evaluation of the refuse management system at the Jersey City operation breakthrough site
[PB-280551/3] N78-31965

**SOLUBILITY**
Fundamental studies of metal fluorination reactions
[COO-2671-7] N78-31202

**SOLUTES**
Radiolysis studies on reactive intermediates --- tunneling and diffusive recombination of solvated electrons
[COO-2086-88] N78-31200
Using topographic characteristics to predict total solute concentrations in streams draining small forested watersheds in Western Montana
[PB-280578/6] N78-31520

**SOLVENT EXTRACTION**
Engineering feasibility study for elimination of nitroglycerin from solvent vapors
[AD-A055980] N78-31192

**SONDES**
Atmospheric density measurement in the middle atmosphere --- betasonde
[AD-A055773] N78-31646

**SOS [SEMICONDUCTORS]**
Radiation effects on MOS/SOS semiconductor devices --- defects in aluminum oxide crystals
[AD-A055925] N78-31934

**SOUND FIELDS**
An acoustic field generated by subsonic jets at low Reynolds numbers
N78-31870

**SOUND GENERATORS**
State-of-the-art of CCD and SAW technologies
N78-31280

**SOUND INTENSITY**
A research program to reduce interior noise in general aviation airplanes: Investigation of the characteristics of an acoustic panel test facility
[NASA-CR-157587] N78-31874
Experimental investigation of outdoor propagation of finite-amplitude noise --- aircraft noise
[NASA-CR-2992] N78-31876

**SOUND TRANSMISSION**
A study of the structural-acoustic response and interior noise levels of fuselage structures
[NASA-CR-157589] N78-31872

**SOUND WAVES**
Impact of charge coupled devices and Surface Acoustic Wave Devices on Signal Processing and Imagery in Advanced Systems --- Conferences
[AGARD-CP-230] N78-31279
State-of-the-art of CCD and SAW technologies
N78-31280
Diffraction effects of baffles on acoustic directivity patterns
N78-31869

**SOUNDING**
The GISS sounding temperature impact test
[NASA-TM-78063] N78-31667

**SOUTH CAROLINA**
Nationwide forestry applications program: Ten-Ecosystem Study [TES] site 5 report, Kershaw County, South Carolina, report 4
[E78-10203] N78-31501

**SPACE EXPLORATION**
A Monte Carlo analysis of science instrument scan sequences for unmanned missions to the planets
N78-31136
Astronauts and cosmonauts biographical and statistical data, revised 31 May 1978
[GPO-30-531] N78-32035

**SPACE PROGRAMS**
International space activities
[GPO-30-920] N78-31137
Aeronautics and space report of the President: The 1977 activities
N78-32015

**SPACE SHUTTLE BOOSTERS**
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 1
[NASA-CR-150791] N78-31159
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 1, section 2
[NASA-CR-150792] N78-31160
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 2
[NASA-CR-150793] N78-31161

**SPACE SHUTTLE PAYLOADS**
The nuclear radiation monitor for the Spacelab/Shuttle
N78-32003

**SPACE SHUTTLES**
Orbit Transfer Vehicle [OTV] engine phase A study
[NASA-CR-150796] N78-31163
Model verification of large structural systems --- space shuttle model response
[NASA-CR-150811] N78-31464

**SPACE SUITS**
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 35
[JPRS-71467] N78-31694
Evolution of the space suit
N78-31695
Spacesuit mobility joints
[NASA-CASE-ARC-11058-1] N78-31735
Spacesuit torso closure
[NASA-CASE-ARC-11100-1] N78-31736

**SPACE TRANSPORTATION SYSTEM**
Disposal of radioactive iodine in space
[NASA-TP-1313] N78-31740

**SPACEBORNE EXPERIMENTS**
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 1
[NASA-CR-135416-VOL-1] N78-31141
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 2 --- bibliography
[NASA-CR-135416-VOL-2] N78-31142

**SPACECRAFT CHARGING**
Spacecraft charging control by thermal, field emission with lanthanum-hexaboride emitters
[NASA-TM-78990] N78-32014

**SPACECRAFT COMMUNICATION**
Link analysis program LINKAN. Volume 1: Theoretical and programmer's manual --- satellite communication links
[ESA-CR[P]-1083-VOL-1] N78-31350
Link analysis program LINKAN. Volume 2: User's manual --- satellite communication links
[ESA-CR[P]-1083-VOL-2] N78-31351

**SPACECRAFT COMPONENTS**
Standard parts list for ESA projects
[ESA-SPEC-QRC-04-ISSUE-1-REV-1] N78-31158

**SPACECRAFT CONFIGURATIONS**
Configuration management requirements --- for ESA spacecraft and associated equipment development
[ESA-SPEC-QRA-03-ISSUE-3] N78-31157

**SPACECRAFT DESIGN**
Liquid rocket engine axial-flow turbopumps
[NASA-SP-8125] N78-31164

**SPACECRAFT ELECTRONIC EQUIPMENT**
Standard parts list for ESA projects
[ESA-SPEC-QRC-04-ISSUE-1-REV-1] N78-31158
Evaluation and qualification of thick film hybrid microcircuits --- for space application
[ESA-SPEC-QRC-06-ISSUE-2-REV-1] N78-31376

**SPACECRAFT ENVIRONMENTS**
The nuclear radiation monitor for the Spacelab/Shuttle
N78-32003

**SPACECRAFT POSITION INDICATORS**
The design and demonstration of an advanced data collection/position locating system, addendum --- coherent demodulator
[NASA-CR-156813] N78-31819

**SPACECRAFT POWER SUPPLIES**
Multi-KW dc distribution system technology research study
[NASA-CR-150789] N78-31353
Evaluation program for secondary spacecraft cells
[NASA-CR-156812] N78-31540

**SPACECRAFT RADIATORS**
Design and development of a gas controlled heat pipe radiator for communication spacecraft application. Life test report
[ESA-CR[P]-1082] N78-31399

**SPACECRAFT STRUCTURES**
Development of solar reflector material with good electrical conductivity. Volume 1: Phase 1 study
[ESA-CR[P]-1069] N78-31180

**SPACECRAFT TRACKING**
Satellite optical tracking: Spin decay and flash observations
N78-32019

**SPACELAB**
The nuclear radiation monitor for the Spacelab/Shuttle
N78-32003

**SPACELAB PAYLOADS**
Definition study of a multidisciplinary European mission. Volume 1: Executive summary
[ESS/SS-777] N78-31138

**SPALLATION**
Measurements of 15.11-MeV gamma-ray flux produced in the reactions C-12[p, p']-C-12'[15.11 MeV] and O-16[p, p' alpha]-C-12'[15.11 MeV]
N78-32007

**SPARK IGNITION**
Impact thresholds for the initiation of metal sparking
[AD-A054738] N78-31189

**SPARKS**
Impact thresholds for the initiation of metal sparking
[AD-A054738] N78-31189

**SPECTRAL LINE WIDTH**
Search for broad gamma ray lines with the UCR double Compton scatter telescope
N78-31981
Cyclotron lines form Her X-1
N78-31991
Theory of the accretion column and cyclotron radiation in X ray pulsars
N78-31998

**SPECTRAL REFLECTANCE**
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 1 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157600] N78-31511
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 2 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157601] N78-31512

**SPECTRAL SIGNATURES**
Analytical techniques for the study of some parameters of multispectral scanner systems for remote sensing
[E78-10200] N78-31498

**SPECTROMETERS**
Characterizing high-energy-formed particulates with the scanning electron microscope/energy dispersive spectrometer system
[UCID-17652] N78-31266
Digital spectrometer scan controller
[COO-913-67] N78-31409
Certain characteristics of the stabilization system of a gamma-ray spectrometer with a light-emitting diode as the source of the reference signal
[UCRL-TRANS-11330] N78-31411
Capabilities of germanium detectors --- gamma ray spectoscopy
N78-32000
Background of a shielded Ge[Li] spectrometer at balloon altitudes
N78-32001
Future directions in experimental gamma ray astronomy --- technology assessment
N78-32005
The ISEE-C gamma ray burst spectrometer
N78-32009
High resolution spectroscopy from low altitude satellites --- gamma ray astronomy
N78-32010
HEAO C-1 gamma-ray spectrometer --- experimental design
N78-32011

**SPECTROSCOPIC ANALYSIS**
Spectroscopic studies of ultraviolet lasing transitions in diatomic molecules
[ORO-5005-16] N78-31423

**SPECTROSCOPY**
Studies in fluorescence spectroscopy
N78-31182

**SPECTRUM ANALYSIS**
An analysis of metallic glasses by Mossbauer spectroscopy
[AD-A055073] N78-31241
The Chirp Z transform with CCD and SAW technology
N78-31312
Spectral analysis using the CCD Chirp Z-transform
N78-31313
Modified maximum entropy spectral analysis of bandlimited signals in low pass noise
[AD-A055258] N78-31331
Least-squares resolution of gamma-ray spectra in environmental samples --- computer program for analyzing sodium iodide gamma spectra
[PB-280237/9] N78-31886
Gamma ray spectroscopy in astrophysics --- conferences
[NASA-TM-79619] N78-31971
Low energy gamma ray observations with the MPI-Compton telescope --- balloon-borne detectors
N78-31980
Confidence about line features in Her X-1 spectrum
N78-31992

**SPECULAR REFLECTION**
Molecular two-dimensional flow of mixtures of light and heavy gases with diffuse and specular reflection --- preliminary experiments for Spacelab
[DLR-FB-77-51] N78-31060
Satellite optical tracking: Spin decay and flash observations
N78-32019

**SPEECH**
Speech compression and evaluation
[AD-A055019] N78-31338
An annotated bibliography of natural language and speech understanding systems
[AD-A055863] N78-31808

**SPEECH RECOGNITION**
An algorithm for determining speech intelligibility
[AD-A055236] N78-31329

**SPIN DYNAMICS**
Deflection of a transversely loaded spinning disk
N78-31455
**SPIN REDUCTION**
Satellite optical tracking: Spin decay and flash observations
N78-32019
**SPLINE FUNCTIONS**
Optimal terrain following controller for an optimized spline reference path
[AD-A055234] N78-31122
**SPRAYERS**
Modified helicopter icing spray system evaluation
[AD-A055039] N78-31091
**SPREAD SPECTRUM TRANSMISSION**
Combined acquisition and fine synchronization system for spread spectrum receivers using a tapped delay line correlator
N78-31319
**SPUTTERING**
Thermodynamic interpretation of secondary ion and photon emission during sputtering of silicon
N78-31912
**STABILITY**
Stability and multicriteria optimization
N78-31862
**STABILITY TESTS**
Frequency domain stability in single and multidimensional systems
[AD-A055393] N78-31841
**STAGE SEPARATION**
Graphics for the hybrid stores separation simulation of the B77 system
[SAND-78-8212] N78-31099
**STANDARDIZATION**
Standard parts list for ESA projects
[ESA-SPEC-QRC-04-ISSUE-1-REV-1]
N78-31158
**STANDARDS**
Development of plating thickness standards
[BDX-613-1709-REV] N78-31272
Solar energy systems. Standards for rubber seals
[PB-280114/0] N78-31444
Improved temperature stability of sulfur dioxide samples collected by the federal reference method
[PB-279873/4] N78-31610
On the question of rapidly setting hygienic standards for industrial substances with irritant action
N78-31701
Air quality criteria for lead
[PB-280411/0] N78-31730
**STARS**
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 1: Selected areas 51, 54, 57, 82, 107
N78-32021
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 2: Selected areas 71, 94, 141; M3, M13, NGC4147
N78-32022
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 3: Milky way fields Perseus 1, NGC 1664, M 37 1, M 37 2, NGC 6067, Sagittarius 1
N78-32023
**STATIC LOADS**
Constant-amplitude and program-load fatigue tests at low cyclic frequencies on thick aluminium alloy pin joints
[ARL-STRUC-REPT-365] N78-31457
**STATIC STABILITY**
Analysis of stability contributions of high dihedral V-tails
[NASA-TM-78729] N78-31044
**STATIC TESTS**
Residual strength tests on fatigue-cracked multifastener specimens of extruded L.65 aluminum alloy
[ARL-STRUC-NOTE-444] N78-31458
**STATISTICAL ANALYSIS**
Statistical model for random errors of position location based on lines of position
[PB-281158/6] N78-31079
Statistical review of counting accelerometer data for Navy and Marine fleet aircraft from 1 Jan. 1962 to 31 Dec. 1977
[AD-A055672] N78-31098
Rotor burst protection program: Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1975
[NASA-CR-135304] N78-31105
Risk analysis in environmental studies. 1: Risk analysis methodology, a statistical approach. 2: Data management for environmental studies
[RHO-SA-33] N78-31597
Analysis of vector wind change with respect to time for Vandenberg Air Force Base, California
[NASA-CR-150776] N78-31663
Computer science and statistics: Annual symposium on the interface
[PB-280370/8] N78-31812
Conditions for strong consistency of M-estimators for location
N78-31846
A way to remove the bias of the chi-square test
N78-31849
A robust class of tests and estimates for multivariate location based on ranks
N78-31852
Bias in the estimates of treatment effects in quasi-experimental evaluations
[PB-280060/5] N78-31861
A statistical sampling of cities: Current and projected involvement in fire prevention and control master planning
[PB-279922/9] N78-31963
**STATISTICAL DISTRIBUTIONS**
A way to remove the bias of the chi-square test
N78-31849
Kolmogorov-Smirnov test statistics for the gamma distribution with unknown parameters
N78-31850
Power comparisons of two-sided tests of equality of two covariance matrices and some distribution theory
N78-31851
**STATISTICAL MECHANICS**
A dual optimization framework for some problems of information theory and statistics
[AD-A055155] N78-31802
**STATISTICAL TESTS**
Statistical test of energy models for prediction of urban growth in Florida
N78-31569
A way to remove the bias of the chi-square test
N78-31849
Testing to determine the underlying distribution using randomly censored data
[AD-A054978] N78-31855
Estimation of the operating characteristics of the two-parameter beta method
[AD-A055611] N78-31860
**STEAM**
Applications of thermal energy storage to process heat storage and recovery in the paper and pulp industry
[NASA-CR-159398] N78-31537
**STEELS**
Alternating tension-compression fatigue strength and property changes of steel after cold deformation at different deformation rates
[RAE-LIB-TRANS-1967] N78-31207
Determination of fatigue performance data on structural materials under typified random loading: Axially loaded notched specimens of mild steel RR St 52 - 3 [SAE 1030]
[TB-127[1978]] N78-31461
**STEEPEST DESCENT METHOD**
Degeneracy in special purpose primal algorithms used in obtaining least absolute value estimators
[AD-A055042] N78-31838
**STELLAR MAGNETIC FIELDS**
Cyclotron emission in neutron star magnetospheres
N78-31995
The excitation of electronic transverse energy levels in an intense magnetic field
N78-31996
The transfer of cyclotron lines through the magnetospheric shell of Hercules X-1
N78-31997
**STELLAR MASS ACCRETION**
Theory of the accretion column and cyclotron radiation in X ray pulsars
N78-31998
**STELLAR MASS EJECTION**
Gamma ray lines from novae --- stellar mass ejection
N78-31989
**STELLAR RADIATION**
Nuclear gamma rays from stellar flares
N78-31977
Gamma-ray lines form neutron stars as probes of fundamental physics
N78-31985
**STELLAR SPECTROPHOTOMETRY**
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 1: Selected areas 51, 54, 57, 82, 107
N78-32021
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 2: Selected areas 71, 94, 141; M3, M13, NGC4147
N78-32022
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 3: Milky way fields Perseus 1, NGC 1664, M 37 1, M 37 2, NGC 6067, Sagittarius 1
N78-32023
**STEREOSCOPY**
Analysis of a cooperative stereo algorithm
[AD-A055099] N78-31899
Representing visual information
[AD-A055045] N78-31951
**STIRLING CYCLE**
Initial test results with a single-cylinder rhombic-drive Stirling engine --- to be applied to automobile engine design to conserve energy
[NASA-TM-78919] N78-31533
**STOCHASTIC PROCESSES**
Stochastic modelling of site wind characteristics
[RLO-2342-77/2] N78-31675
Stochastic modelling of computer systems and networks
N78-31816
Some path properties of p-TH order and symmetric stable processes
[AD-A055844] N78-31857
Variable metric methods and filtering theory
[AD-A055828] N78-31859
**STOCKPILING**
Propellant reassessment program
[AD-A055976] N78-31264
**STORAGE BATTERIES**
Evaluation program for secondary spacecraft cells
[NASA-CR-156812] N78-31540
Design and cost study of a nickel-iron oxide battery for electric vehicles. Volume 2: Public report
[ANL-K-3723-1] N78-31551
**STORAGE RINGS (PARTICLE ACCELERATORS)**
A search for charmed meson production in proton-proton collisions at the CERN-ISR
N78-31887
**STORAGE STABILITY**
Propellant reassessment program
[AD-A055976] N78-31264
**STORM DAMAGE**
The tornado: An engineering-oriented perspective --- wind resistant buildings
[PB-281860/7] N78-31277
**STRAIN GAGES**
Mechanical properties of 0.2 g/cm-3 polystyrene bead foam
[BDX-613-1725-REV] N78-31250
Instrument to measure the initial deformation of rock around underground openings
[PB-279657/1] N78-31659
**STRAIN RATE**
The constant volume hypothesis for the inelastic deformation of metals in the small strain range
[AD-A054253] N78-31215
A nonlinear uniaxial integral constitutive equation incorporative rate effects, creep, and relaxation
[AD-A054252] N78-31216
**STRAPDOWN INERTIAL GUIDANCE**
Theoretical and experimental investigation of computation errors in two different strapdown inertial navigation (IN)-systems
[FOA-C-20217-E4] N78-31080
**STRATIFICATION**
Thermal stratification enhancement for solar energy applications
[AD-A055918] N78-31547
A comparison between derived internal dielectric properties and radio-echo sounding records of the ice sheet at Cape Folger, Antarctica
[AD-A055245] N78-31638
**STREAK CAMERAS**
Streak camera time calibration procedures
[NASA-CR-157573] N78-31403
**STREAMS**
Geological mapping of regional drainage network in Brazil using LANDSAT images
[E78-10185] N78-31484
Using topographic characteristics to predict total solute concentrations in streams draining small forested watersheds in Western Montana
[PB-280578/6] N78-31520
**STRESS (PHYSIOLOGY)**
Instruments and methodology for the assessment of physiological cost of performance of stressful continuous operations: The air traffic services tower environment
N78-31752
**STRESS ANALYSIS**
Laboratory for fatigue life evaluation research reports, issue 8
[ICAF-1045] N78-31460
**STRESS CONCENTRATION**
Continuing crack tip deformation and fracture for plane-strain crack growth in elastic-plastic solids
[COO-3084-56] N78-31472
**STRESS CORROSION**
The role of passive film growth kinetics and properties in stress corrosion and crevice corrosion susceptibility
[AD-A055366] N78-31219
**STRESS CORROSION CRACKING**
Proceedings of AFOSR/AFML Corrosion Workshop
[AD-A055281] N78-31218
EPRI-NASA cooperative project on stress corrosion cracking of Zircaloys --- nuclear fuel failures
[NASA-CR-157577] N78-31230
Detailed analysis of the fundamental ultrasonic response data from stainless steel stress corrosion crack specimens
[EPRI-NP-676-SR] N78-31448
**STRESS RELAXATION**
A nonlinear uniaxial integral constitutive equation incorporative rate effects, creep, and relaxation
[AD-A054252] N78-31216
Instrument to measure the initial deformation of rock around underground openings
[PB-279657/1] N78-31659

**STRESS RELIEVING**
Evaluation of built-in stresses during manufacture of elements made of carbon fiber reinforced plastics
[ESA-CR[P]-1058] N78-31179
**STRESS-STRAIN RELATIONSHIPS**
General aviation airplane structural crashworthiness user's manual. Volume 1: Program KRASH theory
[AD-A055898] N78-31088
Stress-strain behavior of ERNiCr-3 weld filler metal under strain controlled cyclic loading
[ORNL-TM-6128] N78-31228
**STRUCTURAL ANALYSIS**
Structure and dynamics of organic materials under high pressure
N78-31167
Mechanical properties test data for structural materials
[ORNL-5380] N78-31473
**STRUCTURAL DESIGN**
Dulles control tower console design study
[AD-A056200] N78-31132
The tornado: An engineering-oriented perspective -- - wind resistant buildings
[PB-281860/7] N78-31277
Automated design of structures subject to stress, displacement and temperature constraints
N78-31456
Design and installation package for the Sunmat Flat Plate solar collector
[NASA-CR-150741] N78-31536
**STRUCTURAL DESIGN CRITERIA**
Pavement design manual for secondary roads in North Carolina
[PB-280971/3] N78-31275
State-of-the-art for assessing earthquake hazards in the United States. Report 9: Catalogues of strong motion earthquake records. Volume 1: Western United States, 1933-1971
[AD-A055971] N78-31645
**STRUCTURAL ENGINEERING**
Flaw growth in complex structure. Volume 2: Test data
[AD-A054744] N78-31430
**STRUCTURAL MEMBERS**
Architectural construction materials. Part 2, volume 2: Concretes and cements. A bibliography with abstracts
[NTIS/PS-78/0527/8] N78-31274
Impact of rock debris on a simply supported beam
[AD-A055077] N78-31467
**STRUCTURAL RELIABILITY**
The tornado: An engineering-oriented perspective -- - wind resistant buildings
[PB-281860/7] N78-31277
**STRUCTURAL VIBRATION**
Considerations on wing stores flutter: Asymmetry, flutter suppression
[AGARD-R-668] N78-31126
On the multiplicity of solutions of the inverse problem for a vibrating beam
[NASA-CR-157572] N78-31466
**STRUTS**
A new method for solving surface-piercing-strut problems
[AD-A055078] N78-31270
**STUDENTS**
International scientific activities at selected institutions, 1975-1976 and 1976-1977
[PB-280151/2] N78-31943
**SUBMILLIMETER WAVES**
A theoretical and experimental study of Josephson frequency mixers for heterodyne reception in the submillimetre wavelength range
[ESA-CR[P]-1063] N78-31348
**SUBSTITUTES**
Cobalt as an analogue for iron in high temperature experiments on basaltic compositions
N78-31629
**SUBSTRATES**
Material choice for optimum SAW device performance
N78-31282
**SUGAR BEETS**
Atlas of selected crop spectra, Imperial Valley, California
[E78-10201] N78-31499
**SUGAR CANE**
INPE's crop survey program using combined LANDSAT and aircraft data
[E78-10184] N78-31483
Use of LANDSAT data to identify and evaluate areas of sugar cane
[E78-10186] N78-31485
**SULFUR CHLORIDES**
TADIRAN high energy lithium batteries --- inorganic thionyl-chloride electrolytes
[LBR-1501] N78-31544
**SULFUR DIOXIDES**
Flue gas desulfurization systems: Design and operating considerations. Volume 1: Executive summary
[PB-280253/6] N78-31598
Flue gas desulfurization systems: Design and operating considerations. Volume 2: Technical report
[PB-280254/4] N78-31599
Improved temperature stability of sulfur dioxide samples collected by the federal reference method
[PB-279873/4] N78-31610
**SULFURIC ACID**
Development of a portable device to collect sulfuric acid aerosol
[PB-280048/0] N78-31603
**SUPERCHARGERS**
Off design performance of supercharged two stroke diesel engines
N78-31437
**SUPERCONDUCTING POWER TRANSMISSION**
Use of superconductive technology for energy storage and power transmission for large power systems: Power parks
[LA-UR-77-2805] N78-31581
**SUPERCONDUCTORS**
Ductile superconducting wire through novel metallurgical techniques --- using V3Ga
[LBL-7366] N78-31227
Cryogenic recovery analysis of forced flow supercritical helium cooled superconductors
[WFPS-TME-039] N78-31273
Electromagnetic penetration depth in superconducting alloys containing magnetic impurities
[COO-1198-1193] N78-31868
Electron tunneling into the A15 superconductors: Nb3Sn, V3Si, and Nb3Ge
N78-31924
**SUPERCOOLING**
Radiative and gas cooling of falling molten drops
[NASA-TM-78189] N78-31381
**SUPERCRITICAL WINGS**
Control-surface hinge-moment calculations for a high-aspect-ratio supercritical wing
[NASA-TM-78664] N78-31043
**SUPERHIGH FREQUENCIES**
The 20/30 GHz satellite systems technology needs assessment
[NASA-TM-78975] N78-31323
**SUPERNOVAE**
Gamma line radiation from supernovae --- nucleosynthesis
N78-31988
**SUPERSONIC FLIGHT**
The use of ram rockets for high altitude missiles
[DLR-FB-77-47] N78-31153
**SUPERSONIC FLOW**
Development of a computer program to calculate aerodynamic characteristics of bodies and wing-body combinations --- surface pressure distribution in supersonic flow
[AD-A055846] N78-31053
**SUPERSONIC NOZZLES**
The determination of the Laval nozzle exit conditions at too high counterpressure, especially for a propane oxygen gas generator
[DLR-FB-77-45] N78-31057
**SUPERSONIC SPEEDS**
An acoustic field generated by subsonic jets at low Reynolds numbers
N78-31870
**SUPPLYING**
Integrating policy analysis: Study module 7. Volume 2: Technical appendix
[PB-280037/3] N78-31587
**SURFACE ACOUSTIC WAVE DEVICES**
Impact of charge coupled devices and Surface Acoustic Wave Devices on Signal Processing and Imagery in Advanced Systems --- Conferences
[AGARD-CP-230] N78-31279
State-of-the-art of CCD and SAW technologies
N78-31280
The roles for CCD and SAW in signal processing
N78-31281
Material choice for optimum SAW device performance
N78-31282
Microwave surface-acoustic-wave components
N78-31283
Development of a 100MHz bandwidth pulse compression subsystem for airborne application
N78-31284
Influence of acceleration on surface acoustic wave oscillators
N78-31286
Tunable magnetoelastic surface wave oscillators
N78-31287
A hybrid SAW/CCD signal processor
N78-31290
Design and performance of SAW-resonators and resonator-filters
N78-31293
Systems applications of SAW filters and delay lines
N78-31294
The monolithic integration of surface acoustic wave and semiconductor circuit elements on silicon for matched filter device development
N78-31295
Experiments and analysis of acoustoelectric memory correlators
N78-31296
Convolution and correlation memory by means of surface acoustic wave devices
N78-31297
SAW filter application for phased array radar
N78-31300
IRCCD imaging sensors: A review of device options
N78-31302
CCPD: The optimum solid-state line scanner
N78-31303
Reading and acoustic processing of optical images
N78-31304
The Chirp Z transform with CCD and SAW technology
N78-31312
Operation of SAW reflective array pulse compressors in a high performance radar with minus 0.4 meter range resolution
N78-31315
**SURFACE CRACKS**
Measurements of mixed-mode crack surface displacements and comparison with theory
[NASA-CR-157579] N78-31459
**SURFACE ENERGY**
The photomechanical effects as measured by fracture surface energy in KCl
N78-31917
**SURFACE GEOMETRY**
Numerical procedure to determine geometric view factors for surfaces occluded by cylinders
[NASA-TM-78740] N78-31354
**SURFACE LAYERS**
The role of passive film growth kinetics and properties in stress corrosion and crevice corrosion susceptibility
[AD-A055366] N78-31219
**SURFACE PROPERTIES**
Displacement probes with self-contained exciting medium
[NASA-CASE-LAR-11690-1] N78-31406
Electron spectroscopy and low-energy electron diffraction studies of silicon and titanium oxide surfaces
N78-31915
**SURFACE REACTIONS**
Contamination flashover mechanisms of dc transmission line insulators
[HCP/T2068-1] N78-31372
**SURFACE ROUGHNESS**
Thermomechanical effects in sliding wear
[AD-A055318] N78-31431
Topographic studies through texture image analysis of LANDSAT data
[E78-10190] N78-31489
Statistical properties of particles confined by irregular surfaces
N78-31918
**SURFACE TEMPERATURE**
Physically-based high resolution surface wind and temperature analysis for EPAMS
[AD-A055861] N78-31673
**SURFACE WATER**
Heat capacity mapping mission
[E78-10196] N78-31494
**SURFACE WAVES**
Design and performance of SAW-resonators and resonator-filters
N78-31293
**SURGES**
Present techniques of tropical storm surge prediction
[WMO-500] N78-31677
**SURVEYS**
International scientific activities at selected institutions, 1975-1976 and 1976-1977
[PB-280151/2] N78-31943
Report of the 1977 National Survey of science, mathematics, and social studies education
[PB-280192/6] N78-31944
**SURVIVAL EQUIPMENT**
Search and rescue methods and equipment. A bibliography with abstracts
[NTIS/PS-78/0539/3] N78-31066
**SUSPENSION SYSTEMS [VEHICLES]**
Vibration aspects of ride quality modeling for the DOT PTACV: Theory and experiment
[PB-279846/0] N78-31744
**SWEPT WINGS**
Aerodynamic characteristics of a hypersonic research airplane concept having a 70 deg swept double-delta wing at Mach number 0.2
[NASA-TP-1252] N78-31045
**SWITCHING CIRCUITS**
Repetitive series interrupter 2
[AD-A055253] N78-31363
**SYMMETRY**
Symmetry, automorphism and test
[CEPHAG-46/77] N78-31844
**SYNTAX**
Various aspects for correcting and detecting syntactical errors in computer programs
[INPE-1063-NTE/098] N78-31791
**SYNTHETIC APERTURE RADAR**
Synthetic Aperture Radar [SAR] system limitations due to phase errors
[DLR-IB-551-77/2] N78-31349
**SYSTEMS ANALYSIS**
Multi-KW dc distribution system technology research study
[NASA-CR-150789] N78-31353

Certain characteristics of the stabilization system of a gamma-ray spectrometer with a light-emitting diode as the source of the reference signal
[UCRL-TRANS-11330] N78-31411
JPL Energy Consumption Program [ECP] documentation: A computer model simulating, heating, cooling and energy loads in buildings --- low cost solar array efficiency
[NASA-CR-157599] N78-31541
Energy analysis of models of the United States, a summary of progress
N78-31557
Energy analysis, energy quality, and environment
N78-31558
Energy diagrams of published energy analysis of others
N78-31561
Diagnostic improvements in medical ultrasonic imaging systems
N78-31710
Navy Distributed Computer Systems Workshop
[AD-A055080] N78-31766
Algebraic simplification of interconnected systems
[UCID-17760] N78-31843

SYSTEMS ENGINEERING
Development of a 100MHz bandwidth pulse compression subsystem for airborne application
N78-31284
Teper technical evaluation program evaluation and restructuring
[AD-A055757] N78-31343
Real time digital sampler
[LA-TR-78-23] N78-31410
Automotive technology status and projections. Volume 1: Executive summary
[NASA-CR-157593] N78-31428
Automotive technology status and projections. Volume 2: Assessment report
[NASA-CR-157594] N78-31429
Non-tracking solar energy collector system
[NASA-CASE-NPO-13813-1] N78-31526
Solar heating and cooling systems design and development --- prototype development
[NASA-CR-150770] N78-31532
Design data brochure: Solar hot water system
[NASA-CR-150699] N78-31538
The design and demonstration of an advanced data collection/position locating system, addendum --- coherent demodulator
[NASA-CR-156813] N78-31819
An analysis of observed system sensitivity to plant parameter variations
[AD-A055190] N78-31829

## T

T-55 ENGINE
Radiographic examination of T55 engine
[AD-A055108] N78-31113

TABLES [DATA]
Community noise exposure resulting from aircraft operations. Volume 5: Acoustic data on Air Force propeller aircraft
[AD-A055079] N78-31593
Reaction rate and photochemical data for atmospheric chemistry, 1977
[NASA-CR-157610] N78-31607
Current knowledge on numerical data indexing and possible future developments
[PB-279924/5] N78-31953

TACAN
Propagation model [0.1 to 20 GHz] extensions for 1977 computer programs
[AD-A055605] N78-31324

TAIL ASSEMBLIES
Evaluation of a circulation control tail boom for yaw control --- OH-6 helicopter
[AD-A055116] N78-31119

TAIL ROTORS
Antitorque training: Evaluation of effectiveness in reducing mishap losses
[AD-A055040] N78-31092

TANTALUM CARBIDES
Investigation of phase equilibria of TaC fiber reinforced cobalt alloys having a directionally solidified eutectic structure aimed at matrix hardening --- turbine blades
[DLR-FB-77-58] N78-31939

TAPE RECORDERS
Is man the weakest link? --- real time activity recording of aircrew workloads
N78-31746

TARGET ACQUISITION
Display size and target acquisition perforance
[AD-A054624] N78-31741

TARGET RECOGNITION
Computer software for analysis of infrared targets and clutter
[AD-A054235] N78-31796

TASK COMPLEXITY
Determination of stress and strain of air traffic control officers --- physiological response measurements
N78-31751

TEA LASERS
Injection locked, unstable resonator KrF discharge laser with linewidth of 3 GHz
[UCRL-80495] N78-31421

TECHNOLOGICAL FORECASTING
Future needs and opportunities in the air traffic control system
[GPO-98-931] N78-31076
Hydrogen technology, foreign
[AD-A055024] N78-31261

TECHNOLOGY ASSESSMENT
Technical evaluation of flying weapon systems
[RAE-LIB-TRANS-1948] N78-31087
Hydrogen technology, foreign
[AD-A055024] N78-31261
The 20/30 GHz satellite systems technology needs assessment
[NASA-TM-78975] N78-31323
Automotive technology status and projections. Volume 1: Executive summary
[NASA-CR-157593] N78-31428
Automotive technology status and projections. Volume 2: Assessment report
[NASA-CR-157594] N78-31429
Automotive diesel technology program --- computerized design
[SAN-1099-1] N78-31436
Design and cost study for development of lead-acid batteries suitable for electric vehicle propulsion
[ANL-K-77-3624-1] N78-31548
Assessment of low- and intermediate-Btu gasification of coal
[FE-1216-4] N78-31554
Geothermal exploration techniques: A case study
[EPRI-ER-680] N78-31577
Performance evaluation of wind energy conversion systems using the method of bins: Current status
[SAND-77-1375] N78-31580
Control techniques for nitrogen oxides emissions from stationary sources - second edition
[PB-280034/0] N78-31612
Nitrogen oxides: Current status of knowledge
[EPRI-EA-668] N78-31723
Combinatorial optimization: What is the state of the art
[AD-A055722] N78-31842
Hypothetical case studies of operational changes to reduce noise levels
[AD-A055066] N78-31878
Alloys for the fusion reactor environment: A technical assessment
[DOE/ET-0007] N78-31908
TLV [Tracked Levitated Vehicle] status report
[PB-279845/2] N78-31961
Future directions in experimental gamma ray astronomy --- technology assessment
N78-32005
Aeronautics and space report of the President: The 1977 activities
N78-32015

TECHNOLOGY TRANSFER
Some problems of Maryland towns as seen by their mayors
[NASA-TM-79618] N78-31960

TECHNOLOGY UTILIZATION
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 1
[NASA-CR-135416-VOL-1] N78-31141
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 2 --- bibliography
[NASA-CR-135416-VOL-2] N78-31142
High altitude perspective --- cost-reimbursable services using NASA U-2 aircraft
[NASA-SP-427] N78-31508

TECTONICS
Regional investigations of tectonic and igneous geology, Iran, Pakistan, and Turkey
[E78-10197] N78-31495

TELECOMMUNICATION
Telecommunication: Economic studies. A bibliography with abstracts
[NTIS/PS-78/0581/5] N78-31352
Microcomputers. Volume 3, part 2: Telecommunication applications. Citations from the engineering index data base
[NTIS/PS-78/0613/6] N78-31776

TELLURIC LINES
Telluric and D. C. resistivity techniques applied to the geophysical investigation of basin and range geothermal systems
N78-31627

TEMPERATURE
Temperature correlations in turbulent boundary layers
[AD-A055985] N78-31390

TEMPERATURE CONTROL
Solar Control design package
[NASA-CR-150771] N78-31535

TEMPERATURE DISTRIBUTION
Elevated temperature creep and fatigue damage of a 2.25 Cr-1 Mo steel weldment
[SAND-77-1556] N78-31229
Temperature dependence of the dielectric constant of quartz polyimide, part 2
[AD-A055105] N78-31239

TEMPERATURE EFFECTS
Effect of inlet temperature on the performance of a catalytic reactor --- air pollution control
[NASA-TM-78977] N78-31534
The 70 S monosome accumulation and in vitro initiation complex formation by Escherichia coli ribosomes at 5 C
[NASA-CR-157591] N78-31691

TEMPERATURE GRADIENTS
Upper atmosphere wind and temperature profiles over Woomera at twilight
[WRE-TR-1921[W]] N78-31668

TEMPERATURE MEASUREMENT
The GISS sounding temperature impact test
[NASA-TM-78063] N78-31667

TEMPERATURE MEASURING INSTRUMENTS
Application of heat-flow temperature model for remotely assessing near surface soil moisture by thermography
[PB-279616/7] N78-31518
Observations of the Antarctic polar front by a moored array during FDRAKE-76
[PB-281460/6] N78-31686
A method of recording heat parameters of divers during work
N78-31703

TENSILE DEFORMATION
Alternating tension-compression fatigue strength and property changes of steel after cold deformation at different deformation rates
[RAE-LIB-TRANS-1967] N78-31207

TENSILE PROPERTIES
Mechanical properties of 0.2 g/cm-3 polystyrene bead foam
[BDX-613-1725-REV] N78-31250

TENSILE TESTS
System for vacuum pouring of epoxy tensile and impact specimens with a study of the behavior of these specimens at 77 K and 293 K
[ORNL-TM-5493] N78-31178

TERBIUM
Domain orientation in single crystal TbFe[2] and Tb[.27]Dy[.73]Fe[2]
[AD-A055025] N78-31931

TERMINAL GUIDANCE
Three-beacon projectile guidance study
[AD-A055992] N78-31151

TERMINAL VELOCITY
Hybrid trajectory simulation of a parachute system --- low impact velocity two parachute system aerodynamics
[SAND-78-8668] N78-31054

TERRAIN ANALYSIS
Topographic studies through texture image analysis of LANDSAT data
[E78-10190] N78-31489

TERRAIN FOLLOWING AIRCRAFT
The terrain following task for the advanced tactical fighter using discrete optimal control
[AD-A055196] N78-31121
Optimal terrain following controller for an optimized spline reference path
[AD-A055234] N78-31122
Visual workload of the copilot/navigator during terrain flight
[AD-A055038] N78-31742

TEST EQUIPMENT
Antimisting fuel spillage/airshear tests at Naval Weapons Center
[AD-A056113] N78-31256

TEST FACILITIES
Investigation of test facility effects on the three-dimensional boundary layer interaction
[AD-A054237] N78-31386
Three-dimensional inelastic analysis of a small liquid sodium valve
[HEDL-TME-77-91] N78-31435
A research program to reduce interior noise in general aviation airplanes: Investigation of the characteristics of an acoustic panel test facility
[NASA-CR-157587] N78-31874

TEST PILOTS
A pilot evaluation of two G-seat cueing schemes
[NASA-TP-1255] N78-31739

TEST RANGES
Atmospheric conditions at the High Energy Laser Systems Test Facility [HELSTF], White Sands Missile Range, New Mexico 24 March to 8 April 1977
[AD-A055028] N78-31671

TESTS
Functional description of a validation tool for CMS-2 software
[AD-A055973] N78-31805
Symmetry, automorphism and test
[CEPHAG-46/77] N78-31844

TEXTILES
Strong sensitizers
[PB-280475/5] N78-31728

TF-30 ENGINE
TF30 third-stage composite fan blade service program
[AD-A055891] N78-31174

**THEMATIC MAPPING**
An evaluation of the first four LANDSAT-D thematic mapper reflective sensors for monitoring vegetation: A comparison with other satellite sensor systems
[NASA-TM-79617] N78-31510

**THEOREM PROVING**
Mechanical theorem proving and artificial intelligence languages
N78-31781

**THERAPY**
Electrical enhancement of healing in combat injuries to hard and soft tissues
[AD-A055531] N78-31718

**THERMAL ABSORPTION**
Solar pond
[NASA-CASE-NPO-13581-2] N78-31525

**THERMAL CONTROL COATINGS**
Analysis of metal temperature and coolant flow with a thermal-barrier coating on a full-coverage-film-cooled turbine vane
[NASA-TP-1310] N78-31109
Development of solar reflector material with good electrical conductivity. Volume 1: Phase 1 study
[ESA-CR[P]-1069] N78-31180
Effects of compositional changes on the performance of a thermal barrier coating system --- yttria-stabilized zirconia coatings on gas turbine engine blades
[NASA-TM-78976] N78-31212
Proton and electron irradiation of thermal control coatings and polymeric films. Part 1: Experimental part
[ESA-CR[P]-1077-VOL-1] N78-31252
Proton and electron irradiation of thermal control coatings and polymeric films. Part 2: Theoretical part
[ESA-CR[P]-1077-VOL-2] N78-31253

**THERMAL CYCLING TESTS**
Additional thermal cycling tests on solar cell panel samples under vacuum conditions
[DLR-IB-353-78/1] N78-31585

**THERMAL ENERGY**
Hot dry rock, an alternate geothermal energy resource: A challenge for instrumentation
[LA-UR-78-707] N78-31553

**THERMAL POLLUTION**
Thermal performance measurements on ultimate heat sinks: Cooling ponds
[NUREG/CR-0008] N78-31394

**THERMAL RESISTANCE**
Development and evaluation of elastomeric materials for geothermal applications
[JPL-PUB-78-69] N78-31237

**THERMAL STABILITY**
Mechanical stability of retained austenite in tempered 9Ni steel
[AD-A055240] N78-31217
Synthesis of thermally stable polymers
[NASA-CR-157360] N78-31234
Synthesis of perfluoroalkylene aromatic diamines
[NASA-CR-159403] N78-31235
Improved temperature stability of sulfur dioxide samples collected by the federal reference method
[PB-279873/4] N78-31610

**THERMAL VACUUM TESTS**
Design and development of a gas controlled heat pipe radiator for communication spacecraft application. Life test report
[ESA-CR[P]-1082] N78-31399
Additional thermal cycling tests on solar cell panel samples under vacuum conditions
[DLR-IB-353-78/1] N78-31585

**THERMIONIC EMITTERS**
Spacecraft charging control by thermal, field emission with lanthanum-hexaboride emitters
[NASA-TM-78990] N78-32014

**THERMODYNAMIC EQUILIBRIUM**
Investigation of phase equilibria of TaC fiber reinforced cobalt alloys having a directionally solidified eutectic structure aimed at matrix hardening --- turbine blades
[DLR-FB-77-58] N78-31939

**THERMODYNAMIC PROPERTIES**
Effects of thermomechanical processing on strength and toughness of iron - 12-percent-nickel - reactive metal alloys at -196 C
[NASA-TP-1308] N78-31213
Measuring and predicting the dynamic effects of a confined thin metal plate pulse heated into the liquid-vapor regime
[UCRL-52375] N78-31475
Thermal stratification enhancement for solar energy applications
[AD-A055918] N78-31547

**THERMODYNAMICS**
Assessment of low- and intermediate-Btu gasification of coal
[FE-1216-4] N78-31554
On thermodynamics and the nature of the second law for mixtures of interacting continua
[AD-A055102] N78-31940
The dynamic theory, a new view of space, time, and matter
[AD-A055325] N78-31941

**THERMOELECTRIC GENERATORS**
Quality assurance program document for 75 mW radioisotope thermoelectric generator program
[GA-A-14807] N78-31573

**THERMOPHYSICAL PROPERTIES**
Spectral and total emissivity and reflectivity at high temperatures
[AD-A055027] N78-31191

**THERMOPLASTIC RESINS**
Boron trifluoride coatings for thermoplastic materials and method of applying same in glow discharge
[NASA-CASE-ARC-11057-1] N78-31233
Investigation of methylpentene polymer [CPX] molding resin
[BDX-613-1905-REV] N78-31248

**THERMOSTATS**
Solar Control design package
[NASA-CR-150771] N78-31535

**THICK FILMS**
Evaluation and qualification of thick film hybrid microcircuits --- for space application
[ESA-SPEC-QRC-06-ISSUE-2-REV-1] N78-31376

**THICK WALLS**
Study of heat transfer through refractory lined gasifier vessel walls
[FE-2210-18] N78-31385

**THICKNESS**
Development of plating thickness standards
[BDX-613-1709-REV] N78-31272

**THIN FILMS**
The application of exploding thin films to trace metals analysis
N78-31183
Measurements of material properties for solar cells --- aluminum film and KAPTON
[NASA-CR-150797] N78-31531

**THIN PLATES**
Measuring and predicting the dynamic effects of a confined thin metal plate pulse heated into the liquid-vapor regime
[UCRL-52375] N78-31475

**THREE DIMENSIONAL BOUNDARY LAYER**
Investigation of test facility effects on the three-dimensional boundary layer interaction
[AD-A054237] N78-31386
A simple finite-difference technique for the computation of threedimensional incompressible laminar boundary layers. Part 2: Description of the program
[NLR-TR-76086-U-PT-2] N78-31398

**THREE DIMENSIONAL FLOW**
Verification of a three-dimensional turbulent boundary-layer calculation method
[AD-A055606] N78-31388

**THROTTLING**
The influence of throttle augmented stability [APCS] and short period control characteristics on the landing approach
[AD-A055892] N78-31123

**THRUST CONTROL**
Multi-purpose wind tunnel reaction control model block
[NASA-CASE-MSC-19706-1] N78-31129

**THRUST VECTOR CONTROL**
Optimal terrain following controller for an optimized spline reference path
[AD-A055234] N78-31122

**THUNDERSTORMS**
Gust front analytical study
[AD-A056151] N78-31669

**THYRATRONS**
Repetitive series interrupter 2
[AD-A055253] N78-31363

**TIMBER INVENTORY**
AGRESTE project: Agricultural resources investigations in northern Italy and southern France
[E78-10199] N78-31497
Nationwide forestry applications program: Ten-Ecosystem Study [TES] site 5 report, Kershaw County, South Carolina, report 4
[E78-10203] N78-31501
Remeasurement of permanent vegetation plots in the Great Smoky Mountains National Park, Tennessee, USA, and the implications of climatic change on vegetation
[ORNL-TM-6083] N78-31515

**TIME**
Analysis of vector wind change with respect to time for Cape Kennedy, Florida
[NASA-CR-150779] N78-31665

**TIME FUNCTIONS**
Smoothing magic in renewal theory
N78-31834

**TIME LAG**
A comparison of control modes for time delayed remote manipulation
N78-31737

**TIME MEASUREMENT**
Streak camera time calibration procedures
[NASA-CR-157573] N78-31403
Method for obtaining confidence-limit values for seismic values calculated from Vibroseis data
[USGS-474-255] N78-31651

**TIME MEASURING INSTRUMENTS**
Computing LORAN time differences with an HP-25 hand calculator
[NASA-CR-157580] N78-31067

**TIME SERIES ANALYSIS**
Analyzing availability and readiness using transfer function models and cross spectral analysis
[AD-A055724] N78-31447
Time series determination of transfer functions in random fatigue
[AD-A055656] N78-31471

**TIME SHARING**
HISS: An approach to hierarchical system sharing for laboratory computers
[AD-A055152] N78-31769
Validation of closed queueing network models for the DECsystem-10
[AD-A055118] N78-31830

**TIPS**
Contact whiskers for millimeter wave diodes
[NASA-TM-79616] N78-31355
Continuing crack tip deformation and fracture for plane-strain crack growth in elastic-plastic solids
[COO-3084-56] N78-31472

**TITANIUM ALLOYS**
Engineering design data and correlations for nitinol devices --- austenitic martensitic phase transformations
N78-31206
Environmental effects on fatigue of aluminium and titanium alloys
[NLR-MP-77019-U] N78-31463

**TITANIUM OXIDES**
Electron spectroscopy and low-energy electron diffraction studies of silicon and titanium oxide surfaces
N78-31915

**TOMOGRAPHY**
Digital enhancement of computerized axial tomograms
[NASA-TM-78974] N78-31690

**TOPOGRAPHY**
Topographic studies through texture image analysis of LANDSAT data
[E78-10190] N78-31489
Using topographic characteristics to predict total solute concentrations in streams draining small forested watersheds in Western Montana
[PB-280578/6] N78-31520

**TOPOLOGY**
Multiperipheral ring dynamics and a definition of the complete twisted Reggeon loop
[LBL-6199] N78-31938

**TORNADOES**
The tornado: An engineering-oriented perspective --- wind resistant buildings
[PB-281860/7] N78-31277

**TORQUE**
Control-surface hinge-moment calculations for a high-aspect-ratio supercritical wing
[NASA-TM-78664] N78-31043
Antitorque training: Evaluation of effectiveness in reducing mishap losses
[AD-A055040] N78-31092

**TORSO**
Spacesuit torso closure
[NASA-CASE-ARC-11100-1] N78-31736

**TOXIC HAZARDS**
Hazards of organic working fluids
[BNL-50761] N78-31725
Air quality criteria for lead
[PB-280411/0] N78-31730
Physiological response to atmospheric pollutants
[PB-280413/6] N78-31731

**TOXICITY**
Behavior, ecology and toxicity of venomous marine fishes
[AD-A054925] N78-31692
Toxicological evaluation of Pyrethrins Fogging Concentrate [trade name] study No. 51-1309-78
[AD-A055088] N78-31715

**TOXICITY AND SAFETY HAZARD**
On the question of rapidly setting hygienic standards for industrial substances with irritant action
N78-31701
A literature review: Problem definition studies on selected toxic chemicals. Volume 6: Occupational health and safety and environmental aspects of urea-formaldehyde resins
[AD-A054991] N78-31716
Nitrosamines
[PB-280479/7] N78-31727
Strong sensitizers
[PB-280475/5] N78-31728

**TOXICOLOGY**
Toxicological evaluation of Pyrethrins Fogging Concentrate [trade name] study No. 51-1309-78
[AD-A055088] N78-31715

**TRACE ELEMENTS**
The application of exploding thin films to trace metals analysis
N78-31183
A study of the geochemistry of pelagic sediments: The interaction of trace metals and magnetic minerals with sedimentary environments
N78-31631

Deep Ocean Mining Environmental Study [DOMES]. Unpublished manuscript number 20. Data report: Trace metals - DOMES samples
[PB-281098/4] N78-31687

TRACKING FILTERS
A generalized Monte Carlo analysis program for Kalman filter design with application to an aircraft-to-satellite tracking filter
[AD-A055189] N78-31156

TRACKING NETWORKS
Regenerative simulation of response times in networks of Queues II multiple job types
[AD-A055584] N78-31831

TRAFFIC CONTROL
Bearing capacity of river ice for vehicles
[AD-A055244] N78-31637

TRAJECTORIES
A design of trajectory estimator using multiple DME range measurements
[AD-A055191] N78-31077
Trajectory optimization for some sailplane performance problems
N78-31083

TRANSFER FUNCTIONS
Analyzing availability and readiness using transfer function models and cross spectral analysis
[AD-A055724] N78-31447

TRANSFORMATIONS [MATHEMATICS]
Development and application of a SAW Chirp-Z transformer
N78-31311

TRANSFORMERS
Insulation techniques in high voltage high power converters
[ESA-CR[P]-1073] N78-31374

TRANSIENT RESPONSE
Transient response of filters
[AD-A055324] N78-31366
Evaluation of AAFE apparatus to measure residual and transient convection in zero-gravity
[NASA-TM-78191] N78-31382
Transient behavior of solid sensible heat thermal energy storage units
N78-31528

TRANSISTOR AMPLIFIERS
Monolithic 20W 2GHz transistor and monolithic 5W 4GHz transistor
[AD-A055249] N78-31360

TRANSITION FLOW
Instability, transition to turbulence and predictability
[AGARD-AG-236] N78-31401

TRANSITION METALS
Transition metal ion binding by ferritin as studies by electron paramagnetic resonance spectroscopy
N78-31184

TRANSMISSION CIRCUITS
Possibility of attenuating the ecological effects of alternating current power lines as a result of new designs and circuit changes
N78-31708

TRANSMISSION LINES
Review of methods for description of random transmission channels applications to identification and optimisation of detection and transmission processes
[CEPHAG-35/77] N78-31347
Link analysis program LINKAN. Volume 1: Theoretical and programmer's manual --- satellite communication links
[ESA-CR[P]-1083-VOL-1] N78-31350
Link analysis program LINKAN. Volume 2: User's manual --- satellite communication links
[ESA-CR[P]-1083-VOL-2] N78-31351
Contamination flashover mechanisms of dc transmission line insulators
[HCP/T2068-1] N78-31372
Possibility of attenuating the ecological effects of alternating current power lines as a result of new designs and circuit changes
N78-31708

TRANSMISSION LOSS
A study of the structural-acoustic response and interior noise levels of fuselage structures
[NASA-CR-157589] N78-31872

TRANSMISSIONS [MACHINE ELEMENTS]
Helicopter transmission vibration and noise reduction program. Volume 1: Technical report
[AD-A055104] N78-31089

TRANSMITTER RECEIVERS
Combined acquisition and fine synchronization system for spread spectrum receivers using a tapped delay line correlator
N78-31319

TRANSONIC FLOW
The transonic flow on a helicopter rotor
N78-31042
An automated procedure for computing the three-dimensional transonic flow over wing-body combustions, including viscous effects. Volume 2: Program user's manual and code description. Appendix A: Computer code listing and flowchart
[AD-A055109] N78-31050
An automated procedure for computing the three-dimensional transonic flow over wing-body combinations, including viscous effects. Volume 1: Description of analysis methods and applications
[AD-A055899] N78-31052

TRANSPORT AIRCRAFT
Measurements and analysis of the forces acting on a small aircraft flying in the upwash of a large aircraft
[AD-A055286] N78-31048
Study of fuel systems for LH2-fueled subsonic transport aircraft, volume 1
[NASA-CR-145369-VOL-1] N78-31085
Study of fuel systems for LH2-fueled subsonic transport aircraft, volume 2
[NASA-CR-145369-VOL-2] N78-31086
Energy efficient engine: Preliminary design and integration studies
[NASA-CR-135444] N78-31108

TRANSPORT PROPERTIES
Analysis of multistage, axial flow turbomachine wake production, transport, and interaction
[AD-A055754] N78-31118
Procedures for quantifying relationships between photochemical oxidants and precursors: Supporting documentation
[PB-280058/9] N78-31614

TRANSPORT THEORY
Functional analytic treatment of linear transport equations in kinetic theory and neutron transport theory
N78-31888

TRANSPORT VEHICLES
The vibrating environment in transport vehicles: A critical bibliographical study --- human tolerance to vibratory loads
[RAE-LIB-TRANS-1917] N78-31738

TRANSPORTATION
Highway traffic noise. A bibliography with abstracts
[NTIS/PS-78/0634/2] N78-31620

TRANSPORTATION ENERGY
The outlook for automotive fuel supplies, alternative vehicle engines, and potential implications for transportation tax structures [1985-2000]
[PB-279679/5] N78-31440

TRANSVERSE WAVES
Deflection of a transversely loaded spinning disk
N78-31455

TRAPPED PARTICLES
Electrical traps in microwave materials
[AD-A055086] N78-31928
Deep level trap spectroscopy of gallium arsenide
[AD-A055198] N78-31933

TRAVELING WAVE TUBES
Linear 1 kW multitone troposcatter TWT
[AD-A055667] N78-31370

TREES [MATHEMATICS]
Probability intervals for the reliability of complex systems using Monte Carlo simulation
[PB-280191/8] N78-31449

TREES [PLANTS]
Automatic classification of reforested Pinus SPP and Eucalyptus SPP in Mogi-Guacu, SP, Brazil, using LANDSAT data
[E78-10182] N78-31481
Nationwide forestry applications program: Ten-Ecosystem Study [TES] site 5 report, Kershaw County, South Carolina, report 4
[E78-10203] N78-31501

TRINITROTOLUENE
Critical depth tests of bulk TNT flake explosive --- conveyors for handling explosives safely
[AD-A054739] N78-31260

TROPICAL STORMS
Present techniques of tropical storm surge prediction
[WMO-500] N78-31677

TROPOSPHERIC SCATTERING
Linear 1 kW multitone troposcatter TWT
[AD-A055667] N78-31370

TURBINE BLADES
Gas path seal
[NASA-CASE-LEW-12131-2] N78-31103
Analysis of metal temperature and coolant flow with a thermal-barrier coating on a full-coverage-film-cooled turbine vane
[NASA-TP-1310] N78-31109
Advanced ceramic material for high temperature turbine tip seals
[NASA-CR-135319] N78-31238

TURBINE ENGINES
Gas path seal
[NASA-CASE-LEW-12131-2] N78-31103
Turbine engine rotordynamic evaluation, volume 1
[AD-A055262] N78-31111
Turbine tip clearance measurement
[AD-A055765] N78-31115
Rotary expander engine development program
[AD-A055662] N78-31432

TURBINE WHEELS
Heat transfer modeling and analytical quenching of a powder metallurgy turbine disk during heat treatment
[AD-A054022] N78-31110

TURBINES
A theoretical study of the performance of a number of different axial-flow turbine configurations under conditions of pulsating flow
[ARL-MECH-ENG-REPT-149] N78-31104

TURBOCOMPRESSORS
Analysis of multistage, axial flow turbomachine wake production, transport, and interaction
[AD-A055754] N78-31118

TURBOFAN ENGINES
Energy efficient engine: Preliminary design and integration studies
[NASA-CR-135444] N78-31108

TURBOJET ENGINES
Ground impingement of a fan jet exhaust plume
[AD-A054832] N78-31112

TURBOMACHINE BLADES
Rotor burst protection program: Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1975
[NASA-CR-135304] N78-31105
TF30 third-stage composite fan blade service program
[AD-A055891] N78-31174

TURBOSHAFTS
Radiographic examination of T55 engine
[AD-A055108] N78-31113

TURBULENT BOUNDARY LAYER
Boundary-layer and inverse potential-flow methods for axisymmetric bodies
[AD-A054759] N78-31387
Temperature correlations in turbulent boundary layers
[AD-A055985] N78-31390

TURBULENT DIFFUSION
Deep Ocean Mining Environmental Study, DOMES. Unpublished manuscript no. 12: Lagrangian diffusion parameters in the surface water of the tropical North Pacific Ocean
[PB-281388/9] N78-31683

TURBULENT FLOW
Large eddy simulation of incompressible turbulent channel flow
[NASA-CR-157575] N78-31383
Instability, transition to turbulence and predictability
[AGARD-AG-236] N78-31401

TURBULENT JETS
An acoustic field generated by subsonic jets at low Reynolds numbers
N78-31870

TURKEY
Regional investigations of tectonic and igneous geology, Iran, Pakistan, and Turkey
[E78-10197] N78-31495

TWO DIMENSIONAL BODIES
Investigation of optimal linear shift-invariant two-dimensional digital filters
[AD-A055449] N78-31369

TWO DIMENSIONAL FLOW
Molecular two-dimensional flow of mixtures of light and heavy gases with diffuse and specular reflection --- preliminary experiments for Spacelab
[DLR-FB-77-51] N78-31060

TWO PHASE FLOW
On thermodynamics and the nature of the second law for mixtures of interacting continua
[AD-A055102] N78-31940

## U

U.S.S.R.
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 40. Effects on nonionizing electromagnetic radiation
[JPRS-71595] N78-31705

U-2 AIRCRAFT
High altitude perspective --- cost-reimbursable services using NASA U-2 aircraft
[NASA-SP-427] N78-31508

UH-1 HELICOPTER
Use of eye-movement measures to establish design parameters for helicopter instrument panels
N78-31748

ULTRAHIGH FREQUENCIES
Test and evaluation of air/ground communications antennas
[AD-A056148] N78-31325
UHF adaptive array development program
[AD-A055942] N78-31339
UHF scintillation characteristics as observed from Keflavik, Iceland
[AD-A055760] N78-31344

ULTRASONIC TESTS
Development of ultrasonic examination methods for austenitic stainless steel weld inspection
[HEDL-SA-1348] N78-31445
Detailed analysis of the fundamental ultrasonic response data from stainless steel stress corrosion crack specimens
[EPRI-NP-676-SR] N78-31448

Nondestructive ultrasonic testing and inspection, volume 2. Citations from the Engineering Index data base
[NTIS/PS-78/0567/4] N78-31450
Nondestructive ultrasonic testing and inspection, volume 3. Citations from the Engineering Index data base
[NTIS/PS-78/0568/2] N78-31451
Nondestructive ultrasonic testing and inspection, volume 4. Citations from the NTIS data base
[NTIS/PS-78/0565/8] N78-31452
Nondestructive ultrasonic testing and inspection, volume 5. Citation from the NTIS data base
[NTIS/PS-78/0566/6] N78-31453
Interactive signal analysis and ultrasonic data collection system user's manual
[NASA-CR-150798] N78-31763

ULTRASONIC WAVE TRANSDUCERS
Development and evaluation of an ultrasonic imaging system
[PB-279834/6] N78-31729

ULTRASONICS
Diagnostic improvements in medical ultrasonic imaging systems
N78-31710

ULTRAVIOLET LASERS
Spectroscopic studies of ultraviolet lasing transitions in diatomic molecules
[ORO-5005-16] N78-31423

ULTRAVIOLET RADIATION
Hazard analysis of broad-band optical sources
[AD-A054802] N78-31900

ULTRAVIOLET SPECTROPHOTOMETERS
Measurement of 200-400 nm solar UV fluxes at altitudes up to 39 km on the Stratcom 7-A balloon flight
[AD-A055774] N78-32033

UNDERWATER STRUCTURES
Rotating arm experiments for the stable semi-submerged platform [SSP] manuevering predictions
[AD-A055721] N78-31434

UNITED STATES OF AMERICA
Energy analysis of models of the United States
N78-31555
Energy analysis of models of the United States, narrative
N78-31556
Energy analysis of models of the United States, a summary of progress
N78-31557
A meso-model of the economy of the United States for comparison of economic and energetic analysis
N78-31562
A computer version of the US Standard Atmosphere, 1978
[NASA-CR-150778] N78-31632
Analysis of nuclear systems satisfying US energy needs
[GA-A-14848] N78-31891
Report of the 1977 National Survey of science, mathematics, and social studies education
[PB-280192/6] N78-31944

UNIVERSITIES
International scientific activities at selected institutions, 1975-1976 and 1976-1977
[PB-280151/2] N78-31943
Rice University observations of the galactic center
N78-31982
Gamma ray facilities at the University of Maryland cyclotron --- data acquisition and radiation measurement
N78-32008

UNMANNED SPACECRAFT
A Monte Carlo analysis of science instrument scan sequences for unmanned missions to the planets
N78-31136

UNSTEADY FLOW
A theoretical study of the performance of a number of different axial-flow turbine configurations under conditions of pulsating flow
[ARL-MECH-ENG-REPT-149] N78-31104
Investigations on unsteady pressure distribution measurements in rotating systems
[DLR-FB-77-43] N78-31135
Preliminary experiment designed to support a feasibility demonstration of a novel method for developing unsteady boundary layer profiles --- upwash effects of stationary cylinders positioned in wind tunnel
[AD-A055384] N78-31389

UPPER ATMOSPHERE
Upper atmosphere wind and temperature profiles over Woomera at twilight
[WRE-TR-1921(W)] N78-31668

UPWASH
Measurements and analysis of the forces acting on a small aircraft flying in the upwash of a large aircraft
[AD-A055286] N78-31048

URANIUM
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 1 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157600] N78-31511
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 2 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157601] N78-31512

URBAN DEVELOPMENT
LANDSAT [MSS]: Image demographic estimations
[E78-10183] N78-31482
Department of Housing and Urban Development, and certain independent agencies appropriations for fiscal year 1979, part 2
[GPO-23-600] N78-31956
Some problems of Maryland towns as seen by their mayors
[NASA-TM-79618] N78-31960

URBAN PLANNING
Statistical test of energy models for prediction of urban growth in Florida
N78-31569
A statistical sampling of cities: Current and projected involvement in fire prevention and control master planning
[PB-279922/9] N78-31963

URBAN RESEARCH
LANDSAT [MSS]: Image demographic estimations
[E78-10183] N78-31482

USER MANUALS [COMPUTER PROGRAMS]
An automated procedure for computing the three-dimensional transonic flow over wing-body combustions, including viscous effects. Volume 2: Program user's manual and code description. Appendix A: Computer code listing and flowchart
[AD-A055109] N78-31050
AFAL simulation facility/capability manual. Volume 1: Executive summary and Systems Avionics Division
[AD-A055591] N78-31102
A user's guide for REDEQL.EPA. A computer program for chemical equilibria in aqueous systems
[PB-280149/6] N78-31205
Link analysis program LINKAN. Volume 2: User's manual --- satellite communication links
[ESA-CR[P]-1083-VOL-2] N78-31351
JPL Energy Consumption Program [ECP] documentation: A computer model simulating, heating, cooling and energy loads in buildings --- low cost solar array efficiency
[NASA-CR-157599] N78-31541
Interactive signal analysis and ultrasonic data collection system user's manual
[NASA-CR-150798] N78-31763
RSX-11D/DX11-B interface user's guide
[NASA-CR-150809] N78-31795
INTERPOL: An interactive plotting package for off-line Cal Comp systems
[AD-A054762] N78-31800

USER REQUIREMENTS
INPE LANDSAT system
[E78-10180] N78-31479
A summary of the users perspective of LANDSAT-D and reference document of LANDSAT users
[E78-10208] N78-31506
Specification of reliable large-scale software systems
N78-31786

UTAH
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 1 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157600] N78-31511
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 2 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157601] N78-31512

UTILIZATION
Microcomputers: General applications. Citations from the NTIS data base
[NTIS/PS-78/0609/4] N78-31773
Microcomputers. Part 1: General applications. Citations from the engineering index data base
[NTIS/PS-78/0611/0] N78-31774
Microcomputers. Volume 4, Part 1: General applications. Citations from the engineering index data base
[NTIS/PS-78/0612/8] N78-31775
Microcomputers. Volume 3, part 2: Telecommunication applications. Citations from the engineering index data base
[NTIS/PS-78/0613/6] N78-31776
Microcomputers. Part 4: Process control applications. Citations from the engineering index data base
[NTIS/PS-78/0616/9] N78-31779
On the dual-adaptive control and its practical applications
[CEPHAG-52/77] N78-31832


## V


V/STOL AIRCRAFT
Operator workload assessment model: An evaluation of a VF/VA-V/STOL system
N78-31757

VACUUM APPARATUS
System for vacuum pouring of epoxy tensile and impact specimens with a study of the behavior of these specimens at 77 K and 293 K
[ORNL-TM-5493] N78-31178
Two-crystal soft X-ray spectrometer
N78-31402

VACUUM MELTING
Rolling element fatigue testing of gear materials
[NASA-CR-135411] N78-31427

VACUUM TESTS
Evaluation of Amper journal bearings for ISEE-B boom hinge
[ESA-ESTL-29] N78-31439

VALLEYS
Development of vertical dispersion coefficients for deep-valley terrain
[COO-4026-3] N78-31596

VALVES
Three-dimensional inelastic analysis of a small liquid sodium valve
[HEDL-TME-77-91] N78-31435

VANADIUM
The reduction of molecular nitrogen, organic substrates and protons by vanadium[II]
N78-31181
Equation of state of vanadium
[UCID-17696] N78-31226
Electron tunneling into the A15 superconductors: Nb3Sn, V3Si, and Nb3Ge
N78-31924

VANADIUM ALLOYS
Microstructure and magnetic properties of Fe-Cr-Co-V alloys
[LBL-6931] N78-31225

VANADIUM COMPOUNDS
Ductile superconducting wire through novel metallurgical techniques --- using V3Ga
[LBL-7366] N78-31227

VAPOR DEPOSITION
RF plasma enhanced vapor deposition and etching of silicon nitride
[SAND-77-2070] N78-31176

VAPOR PHASES
Design of a flow facility for quantitative spectroscopic studies of high temperature species --- infrared absorption coefficients of boron compounds in the vapor phase
[AD-A054842] N78-31187

VAPOR PRESSURE
New approximation equations for the saturation pressure of water vapor and for humidity parameters used in meteorology
[DLR-FB-77-52] N78-31679

VAPORS
Nonlinear optical polarizabilities of molecules --- in gases and vapors
N78-31894

VARIABLE CYCLE ENGINES
Backup control for a variable cycle engine --- fighter aircraft
[AD-A055658] N78-31116

VARIABLE THRUST
Energy losses in high energy rocket engines with thrust variation
[DLR-FB-77-41] N78-31166

VARIANCE [STATISTICS]
MANOVA multiple comparisons associated with finite intersection tests
[AD-A055842] N78-31858

VARIATIONS
Temperature correlations in turbulent boundary layers
[AD-A055985] N78-31390

VECTOR ANALYSIS
Analysis of vector wind change with respect to time for Cape Kennedy, Florida
[NASA-CR-150779] N78-31665
Singular perturbations of semilinear second order systems
[AD-A055279] N78-31837

VECTORS [MATHEMATICS]
Control system design using vector-valued performance criteria with application to the control rate reduction in parameter insensitive control systems
[DLR-FB-77-55] N78-31125
Maps: A matrix arithmetic programming system
[PB-279859/3] N78-31813

VEGETATION
INPE's crop survey program using combined LANDSAT and aircraft data
[E78-10184] N78-31483
Evaluation of orbital images as a basis for land utilization
[E78-10187] N78-31486
Use of LANDSAT imagery for soil survey
[E78-10189] N78-31488
Use of LANDSAT data to monitor pasture project in Amazonia
[E78-10192] N78-31491
Procedures for gathering ground truth information for a supervised approach to a computer implemented land cover classification of LANDSAT acquired multispectral scanner data --- Mississippi
[E78-10198] N78-31496

An evaluation of the first four LANDSAT-D thematic mapper reflective sensors for monitoring vegetation: A comparison with other satellite sensor systems
[NASA-TM-79617] N78-31510
Remeasurement of permanent vegetation plots in the Great Smoky Mountains National Park, Tennessee, USA, and the implications of climatic change on vegetation
[ORNL-TM-6083] N78-31515
VEGETATION GROWTH
Dynamics of the recovery of damaged tundra vegetation
[ORO-4180-7] N78-31514
VEHICULAR TRACKS
Vibration aspects of ride quality modeling for the DOT PTACV: Theory and experiment
[PB-279846/0] N78-31744
TLV [Tracked Levitated Vehicle] status report
[PB-279845/2] N78-31961
VELOCITY MEASUREMENT
Method for obtaining confidence-limit values for seismic values calculated from Vibroseis data
[USGS-474-255] N78-31651
VENTILATION FANS
Noise generation and noise propagation in centrifugal fans
[DLR-IB-257-78/1] N78-31879
VERTICAL DISTRIBUTION
Development of vertical dispersion coefficients for deep-valley terrain
[COO-4026-3] N78-31596
VERY HIGH FREQUENCIES
Test and evaluation of air/ground communications antennas
[AD-A056148] N78-31325
VESSELS
Study of heat transfer through refractory lined gasifier vessel walls
[FE-2210-18] N78-31385
VIBRATION
Helicopter transmission vibration and noise reduction program. Volume 1: Technical report
[AD-A055104] N78-31089
Flow-induced gate vibrations: Prevention of self-excitation. Computation of dynamic gate behaviour and the use of models
[PUBL-164] N78-31396
VIBRATION DAMPING
Considerations on wing stores flutter: Asymmetry, flutter suppression
[AGARD-R-668] N78-31126
Demonstration of aircraft wing/store flutter suppression systems N78-31128
VIBRATION EFFECTS
Vibration aspects of ride quality modeling for the DOT PTACV: Theory and experiment
[PB-279846/0] N78-31744
VIBRATION ISOLATORS
Dynamic analysis of shipping container suspension system for the canister launched version of the HARPOON missile RGM-84A-3A
[AD-A055719] N78-31433
VIBRATION MEASUREMENT
Displacement probes with self-contained exciting medium
[NASA-CASE-LAR-11690-1] N78-31406
VIBRATIONAL SPECTRA
Optical rotary saturation --- double resonance interaction N78-31896
VIBRATORY LOADS
The vibrating environment in transport vehicles: A critical bibliographical study --- human tolerance to vibratory loads
[RAE-LIB-TRANS-1917] N78-31738
VIDEO DATA
LSI video compression and computational modules utilizing digital charge coupled devices N78-31298
VIEW EFFECTS
Numerical procedure to determine geometric view factors for surfaces occluded by cylinders
[NASA-TM-78740] N78-31354
VINYL POLYMERS
Organic emissions from automobile interiors --- indoor air pollution
[PB-280374/0] N78-31605
VIRGINIA
Proceedings of the Bi-state Conference on the Chesapeake Bay --- emphasis on water pollution control
[PB-282155/1] N78-31626
VISCOUS FLOW
An automated procedure for computing the three-dimensional transonic flow over wing-body combinations, including viscous effects. Volume 1: Description of analysis methods and applications
[AD-A055899] N78-31052
On thermodynamics and the nature of the second law for mixtures of interacting continua
[AD-A055102] N78-31940
VISION
Representing visual information
[AD-A055045] N78-31951
VISUAL PERCEPTION
Bionics. A bibliography with abstracts
[NTIS/PS-78/0550/0] N78-31693
Contrast sensitivity of the human visual system at one luminance level while adapted to a stimulus at another luminance level
[AD-A055238] N78-31717
VOCODERS
Speech compression and evaluation
[AD-A055019] N78-31338
VOICE COMMUNICATION
Pitch and formant analysis of the voice in the investigation of pilot workshop N78-31750
VORTICES
Measurements and analysis of the forces acting on a small aircraft flying in the upwash of a large aircraft
[AD-A055286] N78-31048
Secondary flow vorticity in the passage of a rotor
[AD-A055388] N78-31391
VULNERABILITY
A technique for evaluating fuel and hydraulic fluid ballistic vulnerability
[AD-A055058] N78-31188

## W

WAKES
Analysis of multistage, axial flow turbomachine wake production, transport, and interaction
[AD-A055754] N78-31118
WALL FLOW
Wall boundary layers in cascades
[ARC-CP-1388] N78-31058
Investigation on the influence of a hydrodynamic precursor stage on the heat transfer at a flat channel wall
[ILR-22] N78-31397
WANKEL ENGINES
Rotary expander engine development program
[AD-A055662] N78-31432
WARNING SYSTEMS
Experimental test plan for the evaluation of aircraft separation assurance displays using airline flight simulators
[AD-A055849] N78-31134
WASTE DISPOSAL
Development of an explosive slurry monitor
[AD-A054736] N78-31258
Proposed issuance of a new source National Pollutant Discharge Elimination System Permit No. IA-0060909 to Iowa Southern utilities company, Ottumwa generating station for discharge of wastewaters to the Des Moines River near Ottumwa, Iowa
[PB-280369/0] N78-31617
Disposal of radioactive iodine in space
[NASA-TP-1313] N78-31740
Operation Breakthrough site management systems and pneumatic trash collection, executive summary
[PB-280143/9] N78-31962
Evaluation of the refuse management system at the Jersey City operation breakthrough site
[PB-280551/3] N78-31965
Effects of water-treatment-plant wastes on domestic wastewater treatment processes --- alum sludge disposal
[PB-280970/5] N78-31968
WASTE WATER
Effects of water-treatment-plant wastes on domestic wastewater treatment processes --- alum sludge disposal
[PB-280970/5] N78-31968
Secondary treatment of municipal wastewater in the St. Louis Area - minimal impact expected
[PB-280965/5] N78-31969
WATER
Production method for hydrogen by thermomechanical decomposition of water
[LA-TR-77-52] N78-31265
Fundamental stochastic models of the transport of water and solutes through saturated and unsaturated porous media
[PB-279772/8] N78-31519
Design data brochure: Solar hot water system
[NASA-CR-150699] N78-31538
WATER CIRCULATION
A model for the atmospherically forced circulation in an ocean basin N78-31680
WATER EROSION
Problems associated with maintenance of channel capacity below federal reservoirs in Kansas
[PB-280560/4] N78-31522
WATER MANAGEMENT
A user's guide for REDEQL.EPA. A computer program for chemical equilibria in aqueous systems
[PB-280149/6] N78-31205
Retransmission of hydrometric data in Canada
[E78-10204] N78-31502
Computer processing of LANDSAT digital data and sensor interface development for use in New England reservoir management
[AD-A055762] N78-31513
Water quality management guidance for mine-related pollution sources [new, current and abandoned]
[PB-280625/5] N78-31616
Cypress wetlands for water management, recycling and conservation
[PB-282159/3] N78-31970
WATER POLLUTION
Cleaning coal with coal: Coal humic acids for removal of acids, alkali, salinity, and heavy metal pollutants associated with the use of coal as a fuel
[PB-280580/2] N78-31608
Diversity of stream communities under conditions of pollution stress
[PB-280500/0] N78-31622
Alternative policies for controlling nonpoint agricultural sources of water pollution
[PB-280757/6] N78-31623
Effects of diversion and alum application on two eutrophic lakes
[PB-280983/8] N78-31624
Proceedings of the Bi-state Conference on the Chesapeake Bay --- emphasis on water pollution control
[PB-282155/1] N78-31626
WATER QUALITY
Water quality management guidance for mine-related pollution sources [new, current and abandoned]
[PB-280625/5] N78-31616
WATER RESOURCES
A demonstration of areawide water resources planning --- district of columbia
[PB-280750/1] N78-31521
Catalog of water resources research in Illinois
[PB-280561/2] N78-31523
Public participation in water resources planning: A case study and literature review
[PB-280968/9] N78-31524
WATER TEMPERATURE
Thermal performance measurements on ultimate heat sinks: Cooling ponds
[NUREG/CR-0008] N78-31394
Observations of the Antarctic polar front by a moored array during FDRAKE-76
[PB-281460/6] N78-31686
WATER TREATMENT
Pilot investigation of secondary sludge dewatering alternatives
[PB-280982/0] N78-31967
Effects of water-treatment-plant wastes on domestic wastewater treatment processes --- alum sludge disposal
[PB-280970/5] N78-31968
WATER VAPOR
New approximation equations for the saturation pressure of water vapor and for humidity parameters used in meteorology
[DLR-FB-77-52] N78-31679
WATER WAVES
Present techniques of tropical storm surge prediction
[WMO-500] N78-31677
WAVE PROPAGATION
Material choice for optimum SAW device performance N78-31282
Raman sidescatter instability in a nonuniform plasma --- laser fusion N78-31902
Dynamics of incommensurate charge density waves in electric and magnetic fields N78-31911
WAVE REFLECTION
Design and performance of SAW-resonators and resonator-filters N78-31293
WAVEGUIDES
Demonstration of the microwave ice protection concept
[AD-A055824] N78-31096
WEAPON SYSTEMS
Technical evaluation of flying weapon systems
[RAE-LIB-TRANS-1948] N78-31087
Program analyses for the S-3 weapon system improvement program
[AD-A055887] N78-31093
WEAR
Identification of wear particles, Part 1: preliminary investigations --- metal particles in lubricating oils
[AD-A055126] N78-31240
Thermomechanical effects in sliding wear
[AD-A055318] N78-31431
WEATHER FORECASTING
The GISS sounding temperature impact test
[NASA-TM-78063] N78-31667
WEATHER MODIFICATION
Weather modification
[GPO-20-025] N78-31666
WEIBULL DENSITY FUNCTIONS
A computer program for fitting censored samples to a Weibull distribution [CENWEIR]
[AD-A054833] N78-31856
WEIGHTING FUNCTIONS
A study of weighted distributions and size-biased sampling N78-31847

**WEIGHTLESSNESS**
Evaluation of AAFE apparatus to measure residual and transient convection in zero-gravity
[NASA-TM-78191] N78-31382
Draining characteristics of hemispherically bottomed cylinders in a low-gravity environment
[NASA-TP-1297] N78-31384
**WELD STRENGTH**
Elevated temperature creep and fatigue damage of a 2.25 Cr-1 Mo steel weldment
[SAND-77-1556] N78-31229
**WELD TESTS**
Development of ultrasonic examination methods for austenitic stainless steel weld inspection
[HEDL-SA-1348] N78-31445
**WELDED JOINTS**
Reliability in the design of welded structures
N78-31438
**WELDING**
An interactive program for the analysis of fatigue data
N78-31476
**WETLANDS**
Cypress wetlands for water management, recycling and conservation
[PB-282159/3] N78-31970
**WHEAT**
Assessment of the damage caused by the frost of 1975 to coffee and wheat crops in the northwest of the state of Parana using LANDSAT images with automatic classification
[E78-10193] N78-31492
Analytical techniques for the study of some parameters of multispectral scanner systems for remote sensing
[E78-10200] N78-31498
Atlas of selected crop spectra, Imperial Valley, California
[E78-10201] N78-31499
Nationwide forestry applications program: Procedure 1 applicability to rangeland classification --- Weld County, Colorado
[E78-10202] N78-31500
Linear feature selection with applications
[E78-10206] N78-31504
Analysis of scanner data for crop inventories
[E78-10207] N78-31505
**WHISKERS [SINGLE CRYSTALS]**
Contact whiskers for millimeter wave diodes
[NASA-TM-79616] N78-31355
**WHITE NOISE**
Modified maximum entropy spectral analysis of bandlimited signals in lowpass noise
[AD-A055258] N78-31331
**WIND [METEOROLOGY]**
Analysis of vector wind change with respect to time for Cape Kennedy, Florida
[NASA-CR-150779] N78-31665
Physically-based high resolution surface wind and temperature analysis for EPAMS
[AD-A055861] N78-31673
**WIND DIRECTION**
Analysis of wind bias change with respect to time at Cape Kennedy, Florida, and Vandenberg AFB, California
[NASA-CR-150777] N78-31664
**WIND MEASUREMENT**
WNDROS: A program for displaying wind rose data
[ORNL-CSD-TM-40] N78-31674
**WIND PRESSURE**
The tornado: An engineering-oriented perspective --- wind resistant buildings
[PB-281860/7] N78-31277
**WIND PROFILES**
Upper atmosphere wind and temperature profiles over Woomera at twilight
[WRE-TR-1921(W)] N78-31668
**WIND SHEAR**
Simulation of the urban neutral boundary layer for the model study of wind loads on tall buildings
[PB-280787/3] N78-31278
Gust front analytical study
[AD-A056151] N78-31669
**WIND TUNNEL MODELS**
Analysis of stability contributions of high dihedral V-tails
[NASA-TM-78729] N78-31044
Simulation of the urban neutral boundary layer for the model study of wind loads on tall buildings
[PB-280787/3] N78-31278
**WIND TUNNEL NOZZLES**
Multi-purpose wind tunnel reaction control model block
[NASA-CASE-MSC-19706-1] N78-31129
**WIND TUNNEL TESTS**
Two-dimensional subsonic wind tunnel evaluation of two related cambered 15-percent thick circulation control airfoils
[AD-A055140] N78-31047
Aeroballistics of corkscrew projectiles
[AD-A054735] N78-31049
Results of a wind tunnel and flight test program to develop a Maximum Volume Bomb [MVB configuration for multiple carriage and separation from tactical-aircraft at mach numbers from 0.50 to 1.10
[AD-A055029] N78-31051
Investigations of a highly loaded compressor cascade with a control of the blade boundary layer. Part 5: Experimental investigations on the cascade with slotted blades
[DLR-IB-151-77/14] N78-31056
Multi-purpose wind tunnel reaction control model block
[NASA-CASE-MSC-19706-1] N78-31129
Single and dual air curtain jets used as protection against precipitation
[UTIAS-227] N78-31269
Preliminary experiment designed to support a feasibility demonstration of a novel method for developing unsteady boundary layer profiles --- upwash effects of stationary cylinders positioned in wind tunnel
[AD-A055384] N78-31389
Giromill wind tunnel test and analysis. Volume 1: Executive summary
[COO-2617-4/1-VOL-1] N78-31579
**WIND VARIATIONS**
Analysis of vector wind change with respect to time for Vandenberg Air Force Base, California
[NASA-CR-150776] N78-31663
Stochastic modelling of site wind characteristics
[RLO-2342-77/2] N78-31675
**WINDPOWER UTILIZATION**
State-of-the-art reviews and bibliographies on energy. A bibliography with abstracts
[NTIS/PS-78/0586/4] N78-31586
**WINDPOWERED GENERATORS**
Giromill wind tunnel test and analysis. Volume 1: Executive summary
[COO-2617-4/1-VOL-1] N78-31579
Performance evaluation of wind energy conversion systems using the method of bins: Current status
[SAND-77-1375] N78-31580
**WING TIPS**
Measurements and analysis of the forces acting on a small aircraft flying in the upwash of a large aircraft
[AD-A055286] N78-31048
**WING-FUSELAGE STORES**
Considerations on wing stores flutter: Asymmetry, flutter suppression
[AGARD-R-668] N78-31126
Asymmetric store flutter
N78-31127
Demonstration of aircraft wing/store flutter suppression systems
N78-31128
**WIRE**
Ductile superconducting wire through novel metallurgical techniques --- using V3Ga
[LBL-7366] N78-31227
Applications of a charge coupled device sensor for Nap-of-the-Earth helicopter operations
N78-31305
Contact whiskers for millimeter wave diodes
[NASA-TM-79616] N78-31355
**WIRING**
Experimental determinations of temperatures and power losses at the electrical connections of some duplex receptacles
[PB-280071/2] N78-31378
**WORDS [LANGUAGE]**
On the epistemological status of semantic networks
[AD-A055048] N78-31337
**WORK CAPACITY**
Work Capability and physiological effects Predictive studies. 4: in HE-02 excursions to pressures of 400-800-1200- and 1600 feet of sea water
[NASA-CR-157571] N78-31714
**WORKING FLUIDS**
Hazards of organic working fluids
[BNL-50761] N78-31725
**WORKLOADS [PSYCHOPHYSIOLOGY]**
Methods to assess work load
[AGARD-CP-216] N78-31745
Methodological considerations of visual workloads of helicopter pilots --- eye movement measurements
N78-31747
Auditory communication and workload --- human response time measurements to voice communication
N78-31749
Pitch and formant analysis of the voice in the investigation of pilot workshop
N78-31750
Determination of stress and strain of air traffic control officers --- physiological response measurements
N78-31751
Instruments and methodology for the assessment of physiological cost of performance of stressful continuous operations: The air traffic services tower environment
N78-31752
Physiological measures of workloads: Correlations between physiological parameters and operational performance
N78-31753
Use of Inspiratory Minute Volumes in evaluation of rotary and fixed wing pilot workload --- respiratory response to flight conditions
N78-31754
Neurophysiological assessment of functional states of the brain --- electroencephalographic responses to workloads
N78-31755
The human operator simulator: Workload estimation using a simulated secondary task
N78-31756
Operator workload assessment model: An evaluation of a VF/VA-V/STOL system
N78-31757
Mathematical analysis and computer simulation in military mission workload assessment
N78-31758
**WORLD METEOROLOGICAL ORGANIZATION**
World Weather Watch. The role of satellites in WMO programmes in the 1980s
[WMO-494] N78-31676
**WYOMING**
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 1 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157600] N78-31511
A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 2 --- spectral reflectance of rocks in Utah and Wyoming
[NASA-CR-157601] N78-31512

## X

**X RAY ANALYSIS**
Characterizing high-energy-formed particulates with the scanning electron microscope/energy dispersive spectrometer system
[UCID-17652] N78-31266
**X RAY ASTRONOMY**
A hard X-ray and gamma ray observation of the 22 November 1977 solar flare --- experimental design
N78-31974
**X RAY DIFFRACTION**
Investigation of propellant and explosive solid solution systems II X-ray studies
[AD-A055981] N78-31263
**X RAY SCATTERING**
Strain induced plastic-to-rubber transition of an SBS block copolymer and its blend with PS
[AD-A055905] N78-31246
**X RAY SOURCES**
Cyclotron lines form Her X-1
N78-31991
Confidence about line features in Her X-1 spectrum
N78-31992
Upper limits on the cyclotron lines from Her X-1 as observed with OSO-8
N78-31993
HEAO-1 observations of Her X-1 at energies above 13 keV
N78-31994
Theory of the accretion column and cyclotron radiation in X ray pulsars
N78-31998
**X RAY SPECTRA**
Galactic center iron line emission
N78-31987
The transfer of cyclotron lines through the magnetospheric shell of Hercules X-1
N78-31997
X-ray observations of BL Lac objects
[NASA-TM-79625] N78-32016
High energy X-ray spectra of cygnus XR-1 observed from OSO-8
[NASA-TM-79626] N78-32017
**X RAY SPECTROSCOPY**
Two-crystal soft X-ray spectrometer
N78-31402
Confidence about line features in Her X-1 spectrum
N78-31992
**XEROGRAPHY**
Xerox controller design
[AD-A055224] N78-31771

## Y

**YAG LASERS**
Output power variations in Nd:YAG laser hosts --- yttrium-aluminum garnet
[AD-A055180] N78-31416
**YAW**
Evaluation of a circulation control tail boom for yaw control --- OH-6 helicopter
[AD-A055116] N78-31119
**YIELD STRENGTH**
Effects of thermomechanical processing on strength and toughness of iron - 12-percent-nickel - reactive metal alloys at -196 C
[NASA-TP-1308] N78-31213
**YTTRIUM ALLOYS**
Structure of gain boundaries in silicon nitride based alloys --- electron microscopy of MgO, Y2O3, and magnesium-sialon
[LBL-6985] N78-31177

Effects of compositional changes on the performance of a thermal barrier coating system --- yttria-stabilized zirconia coatings on gas turbine engine blades
[NASA-TM-78976] N78-31212

YTTRIUM-ALUMINUM GARNET
Output power variations in Nd:YAG laser hosts --- yttrium-aluminum garnet
[AD-A055180] N78-31416

## Z

ZIRCALOYS [TRADEMARK]
EPRI-NASA cooperative project on stress corrosion cracking of Zircaloys --- nuclear fuel failures
[NASA-CR-157577] N78-31230

ZIRCONATES
Quantizing the polarization of lead zirconate-titanate
[LBL-7322] N78-31937

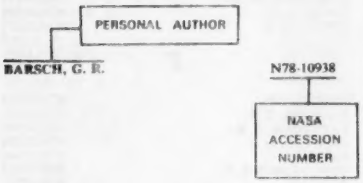
ZIRCONIUM OXIDES
Effects of compositional changes on the performance of a thermal barrier coating system --- yttria-stabilized zirconia coatings on gas turbine engine blades
[NASA-TM-78976] N78-31212

# PERSONAL AUTHOR INDEX





## Typical Personal Author Index Listing




Listings in this Index are arranged alphabetically by personal author. The NASA accession number denotes the number by which the citation is identified.


## A

ABBEY, O. D. N78-31394
ABRAMS, M. J. N78-31511
N78-31512
ABRAMSON, J. N78-31047
ABSHIRE, J. B. N78-31413
ACHENBACH, J. D. N78-31470
ACKLEY, S. F. N78-31638
ADAIR, J. E. N78-31366
ADAMS, G. R. N78-31318
ADAMS, J. W. N78-31204
ADAMS, R. C. N78-31820
ADELFANG, S. I. N78-31663
N78-31664
N78-31665
ADLERSTEIN, M. N78-31928
AFONIN, I. P. N78-31883
AKERS, L. A. N78-31754
AKIN, D. L. N78-31798
AKINS, R. E. N78-31580
ALBANESE, R. A. N78-31758
ALDRED, A. T. N78-31195
ALEXANDER, J. F., JR. N78-31555
N78-31557
N78-31561
N78-31565
ALEXANDER, S. T. N78-31331
ALLEN, B. C. N78-31798
ALLEN, C. B. N78-31589
ALLEN, R. A. N78-31298
ALTHOF, W. N78-31251
ALTIERO, N. J., JR. N78-31459
ALTORFER, H. N78-31231
ALWANG, J. R. N78-31114
AMAT, M. T. N78-31252
AMBROSE, J. R. N78-31219
AMDUR, M. O. N78-31731
AMOS, W. N78-31093
AMUNDSEN, C. C. N78-31514
ANDERSON, D. N. N78-31534
ANDERSON, J. A. N78-31609
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AUSTIN, J. W. N78-31139

## B

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## C

CAHOON, J. L. N78-31721
CAIRELLI, J. E. N78-31533
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CUTLER, E. P. N78-31993

## D

DADONE, A. N78-31437
DAILEDA, J. J. N78-31129
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DERENZO, S. E. N78-31721
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DESANTIS, R. M. N78-31864
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DIAMANT, J. N78-31246
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DYAL, P. N78-32006
DYER, P.

## E

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EDMISTON, W.

EDWARDS, B. H.
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EISELLE, F. L.
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ERM, L. N78-31104
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EWING, J. J. N78-31422

## F

FABER, J. M. N78-31754
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FULTZ, P. N78-31217

## G

GALAKTIONOVA, G. V. N78-31707
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## I

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IVKIN, M. V. N78-31883

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## L

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MYERS, C. G. N78-31344
MYERS, R. E. N78-31507

## N

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## O

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## P

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POGGIO, T. N78-31899
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PRIOR, Y. N78-31896
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PROSCHAN, F. N78-31446
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PUTYATIN, S. P. N78-31708

## Q

QUINONES, D. F. N78-31474
QUIRK, W. J. N78-31667

## R

RADPOUR, A. N78-31365
RAIMONDO, S. N78-31269
RAINES, A. E. N78-31800
RAINEY, D. A. N78-31509
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ROBERTSON, J. W. N78-31767
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RYAN, J. M. N78-31981

## S

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SANDER, H. R. N78-31207
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SANDERS, M. G. N78-31742
SANMIGUEL, A. N78-31256
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SAVAGE, H. T. N78-31931
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SCHEIDEGG, C. P. N78-31717
SCHLATTER, E. C. N78-31674
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SCROGER, M. G. N78-31378
SCRUGGS, R. M. N78-31388
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SECKEL, E. N78-31123

SEDLACEK, W. A. N78-31936
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SELCUK, M. K. N78-31526
SELLE, J. E. N78-31224
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SEMBONGI, S. N78-31123
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SHINDELMAN, A. V. N78-31411
SHOFFSTALL, D. R. N78-31615
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SIDNER, C. N78-31801
SIEMENS, K. N78-31291
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STRZHIZHOVSKIY, A. D. N78-31707
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T

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TAYLOR, W. N78-31818
TEEGARDEN, B. J. N78-32009
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TEES, W. G. N78-31339
TELLINGHUISEN, J. B. N78-31423
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THIEME, L. G. N78-31533
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THOMASSON, J. W. N78-31868
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TOMKINS, R. P. T. N78-31589
TOPAKTAS, L. N78-32023
TOURNOIS, P. N78-31297
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TOY, W. M. N78-31612
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TSIRONIS, C. N78-31877
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TULLOCH, J. S. N78-31091
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TURCAT, C. N78-31844
TURNER, R. F. N78-31891
TURNER, T. E. N78-31367
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TURUNEN, T. N78-31636
TUYAHOV, A. J. N78-31506
TWADELL, W. M. N78-31356
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N78-31358

U

ULLMAN, D. G. N78-31529
UNGAR, S. G. N78-31499
UNKEL, W. C., JR. N78-31905
URBENAJO, R. N78-31541
UTTS, J. M. N78-31852

V

VAHALA, G. N78-31907
VAILL, R. E. N78-31551
VALDOIS, M. N78-31286
VANAKEN, J. N78-31874
VANALLEN, R. E. N78-31136
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VANDAM, C. P. G. N78-31873
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VANDEVAART, H. N78-31285
VANDYKE, P. N78-31048
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VANHOVE, R. N78-31317
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VERSAW, E. F. N78-31085
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VETLOV, I. P. N78-31676
VILENCHIK, M. M. N78-31709
VILLAUME, J. E. N78-31716
VINSON, P. W. N78-31108
VISWANATHAN, R. N78-31338
VITERI, F. N78-31164
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VOGELOONG, T. L. N78-31309
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VONGLAHN, U. H. N78-31871
VOORHEES, J. R. N78-31968
VULETICH, T. N78-31721
VYKUKAL, H. C. N78-31735
N78-31736

W

WAAS, R. C. N78-31359
WADDELL, G. G. N78-31659
WAGNER, C. A. N78-31633
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WAGNER, R. N78-32022
WAIBEL, R. T. N78-31615
WAKABAYASHI, N. N78-31197
WALL, N. S. N78-32007
WALLACE, R. W. N78-31291
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WALLS, F. L. N78-31880
WALLSCHLAEGER, W. H. N78-31140
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WALTERS, D. N78-31671
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WARNER, W. P. N78-31766
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WEBER, O. N78-31081
WEBSTER, D. A. N78-31876
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WEHR, S. E. N78-31065
WEI, M. C. M. N78-31814
WEINBERG, A. M. N78-31890
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WEINER, E. O. N78-31435
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**WITHEROW, W. K.** N78-31382
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**WULF, H. J.** N78-31307
**WYNNE, J. J.** N78-31186

## Y

**YADAVA, K. G.** N78-31346
**YAMAMOTO, K.** N78-31870
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N78-32023
**YOUNG, M. E.** N78-31959
**YU, K. Y.** N78-31310
**YU, P. S. L.** N78-31816

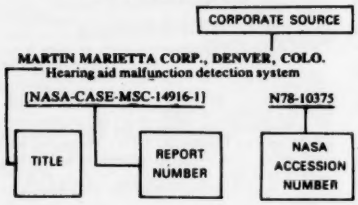
## Z

**ZABRODIN, V. V.** N78-31702
**ZARITSKY, I. S.** N78-31765
**ZAVESKY, R.** N78-31155
**ZENK, W. F.** N78-31686
**ZIVI, S. M.** N78-31889
**ZLOBEC, S.** N78-31803
**ZOLNOWSKY, J. E.** N78-31783
**ZONES, S. I.** N78-31181
**ZWEIDINGER, R. A.** N78-31605
**ZYCH, A. D.** N78-31981
**ZYRYANOV, L. A.** N78-31411

# CORPORATE SOURCE INDEX



## Typical Corporate Source Index Listing




Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The NASA accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

## A

**ACUREX CORP., MOUNTAIN VIEW, CALIF.**
Control techniques for nitrogen oxides emissions from stationary sources - second edition
[PB-280034/0] N78-31612

**ADDIS TRANSLATIONS INTERNATIONAL, PORTOLA VALLEY, CALIF.**
Certain characteristics of the stabilization system of a gamma-ray spectrometer with a light-emitting diode as the source of the reference signal
[UCRL-TRANS-11330] N78-31411

**ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, PARIS [FRANCE].**
Considerations on wing stores flutter: Asymmetry, flutter suppression
[AGARD-R-668] N78-31126
Impact of charge coupled devices and Surface Acoustic Wave Devices on Signal Processing and Imagery in Advanced Systems
[AGARD-CP-230] N78-31279
Instability, transition to turbulence and predictability
[AGARD-AG-236] N78-31401
An introduction to turbulence in geophysics and air-sea interactions
[AGARD-AG-232] N78-31661
Methods to assess work load
[AGARD-CP-216] N78-31745

**AEG-TELEFUNKEN, BACKNANG [WEST GERMANY].**
Insulation techniques in high voltage high power converters
[ESA-CR[P]-1073] N78-31374

**AEG-TELEFUNKEN, ULM [WEST GERMANY].**
Design and performance of SAW-resonators and resonator-filters
N78-31293
A CCD memory chip for radar image processing
N78-31307

**AERODYNE RESEARCH, INC., BEDFORD, MASS.**
Design of a flow facility for quantitative spectroscopic studies of high temperature species
[AD-A054842] N78-31187

**AEROJET LIQUID ROCKET CO., SACRAMENTO, CALIF.**
Orbit Transfer Vehicle [OTV] engine phase A study
[NASA-CR-150796] N78-31163

**AERONAUTICAL RESEARCH LABS., MELBOURNE [AUSTRALIA].**
A theoretical study of the performance of a number of different axial-flow turbine configurations under conditions of pulsating flow
[ARL-MECH-ENG-REPT-149] N78-31104
Constant-amplitude and program-load fatigue tests at low cyclic frequencies on thick aluminium alloy pin joints
[ARL-STRUC-REPT-365] N78-31457
Residual strength tests on fatigue-cracked multi-fastener specimens of extruded L.65 aluminum alloy
[ARL-STRUC-NOTE-444] N78-31458

**AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OHIO.**
Cargo aircraft and spacecraft forward restraint criteria
[AD-A055343] N78-31095

**AEROSPACE CORP., EL SEGUNDO, CALIF.**
Temperature correlations in turbulent boundary layers
[AD-A055985] N78-31390

**AEROSPACE MEDICAL RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.**
Community noise exposure resulting from aircraft operations. Volume 5: Acoustic data on Air Force propeller aircraft
[AD-A055079] N78-31593

**AGRICULTURAL RESEARCH SERVICE, PHOENIX, ARIZ.**
Heat capacity mapping mission
[E78-10196] N78-31494

**AIR FORCE ACADEMY, COLO.**
Molecular orbital calculations on molecules of Air Force interest
[AD-A055072] N78-31881

**AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.**
Identification of wear particles, Part 1: preliminary investigations
[AD-A055126] N78-31240

**AIR FORCE AVIONICS LAB., WRIGHT-PATTERSON AFB, OHIO.**
Transient response of filters
[AD-A055324] N78-31366

**AIR FORCE FLIGHT DYNAMICS LAB., WRIGHT-PATTERSON AFB, OHIO.**
Investigation of test facility effects on the three-dimensional boundary layer interaction
[AD-A054237] N78-31386

**AIR FORCE GEOPHYSICS LAB., HANSCOM AFB, MASS.**
Measurements of atmospheric density at Kwajalein Atoll, 18 May 1977
[AD-A054784] N78-31640

**AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OHIO.**
A design of trajectory estimator using multiple DME range measurements
[AD-A055191] N78-31077
Performance in a jamming environment of a low-cost GRS user receiver algorithm for aiding a tactical INS
[AD-A055239] N78-31078
An extended Kalman filter fire control system against air-to-air missiles volume I
[AD-A055179] N78-31090
The terrain following task for the advanced tactical fighter using discrete optimal control
[AD-A055196] N78-31121
Optimal terrain following controller for an optimized spline reference path
[AD-A055234] N78-31122
Software design for a Visually-Coupled Airborne Systems Simulator [VCASS]
[AD-A055226] N78-31133
Investigation of real-time satellite-to-satellite tracking using extended Kalman filters
[AD-A055115] N78-31148
Application of a maximum likelihood parameter estimator to an advanced missile guidance and control system
[AD-A055188] N78-31149
Structured analysis and design of a satellite simulator
[AD-A055192] N78-31150
A generalized Monte Carlo analysis program for Kalman filter design with application to an aircraft-to-satellite tracking filter
[AD-A055189] N78-31156
An analysis of metallic glasses by Mossbauer spectroscopy
[AD-A055073] N78-31241
A random point process model for atmospheric radio noises
[AD-A055123] N78-31326
Performance analysis of continuous-phase frequency shift keying modulation in atmospheric noise
[AD-A055194] N78-31327
An algorithm for determining speech intelligibility
[AD-A055236] N78-31329
Evaluation of coherent FSK performance in atmospheric radio noise
[AD-A055237] N78-31330
Analysis of monopole antenna arrays on cylinders by the geometrical theory of diffraction
[AD-A055197] N78-31335
The effect of polarization diversity on receiving systems
[AD-A055450] N78-31345
Damper winding reactance
[AD-A055199] N78-31364
Investigation of optimal linear shift-invariant two-dimensional digital filters
[AD-A055449] N78-31369
Output power variations in Nd:YAG laser hosts
[AD-A055180] N78-31416
The laser lightning rod system: A feasibility study
[AD-A055255] N78-31417
Absorptance of IR laser radiation at a metallic interface at various angles of incidence and polarizations
[AD-A055256] N78-31418
Reaction-R constants and simple rate theories applied to the mercury-chloride laser
[AD-A055229] N78-31419
Contrast sensitivity of the human visual system at one luminance level while adapted to a stimulus at another luminance level
[AD-A055238] N78-31717
Description and analysis of the Hewlett-Packard 78220 arrhythmia monitoring system
[AD-A055451] N78-31720
Design of a microprocessor based system for testing of the NCR 2051 MNOS memory
[AD-A055200] N78-31767
Xerox controller design
[AD-A055224] N78-31771
Preliminary design for multimode matrix perception experiment software
[AD-A055178] N78-31797
Simulation of the direct execution of a higher order language
[AD-A055235] N78-31798
Software tool [S] for evaluating the effects of finite worldlength
[AD-A055777] N78-31806
A distributed mini-computer network
[AD-A055254] N78-31820
An analysis of observed system sensitivity to plant parameter variations
[AD-A055190] N78-31829
Validation of closed queueing network models for the DECsystem-10
[AD-A055118] N78-31830
Electrical profiling of magnesium implanted gallium phosphide
[AD-A055195] N78-31929
Use of a metal-nitride-oxide-semiconductor as the detector for a radiation dosimeter
[AD-A055187] N78-31932
Deep level trap spectroscopy of gallium arsenide
[AD-A055198] N78-31933
Simulation of the acquisition management information system
[AD-A055209] N78-31945

**AIRESEARCH MFG. CO., TORRANCE, CALIF.**
Preliminary evaluation of tubular ceramic heat exchanger materials
[TID-28279] N78-31393

**ALABAMA UNIV., HUNTSVILLE.**
Measurements of material properties for solar cells
[NASA-CR-150797] N78-31531

**ALABAMA UNIV., UNIVERSITY.**
The vinyl reactivity of [eta[5]-vinylcyclopentadienyl] dicarbonyl nitrosylchromium. A novel vinyl organometallic monomer
[AD-A055012] N78-31169

**ALFRED UNIV., N.Y.**
Fabrication and mechanical properties of alumina fiber-alumina matrix composites
N78-31171

**ALLEN CLARK RESEARCH CENTRE, TOWCESTER [ENGLAND].**
Performance limitations of two phase CCD's N78-31288
Charge coupled devices with simplified drive requirements N78-31299
**AMERICAN COUNCIL ON EDUCATION, WASHINGTON, D.C.**
International scientific activities at selected institutions, 1975-1976 and 1976-1977 [PB-280151/2] N78-31943
**AMERICAN ELECTRONIC LABS., INC., LANSDALE, PA.**
Walsh adaptive filter [AD-A055170] N78-31328
**AMES LAB., IOWA.**
Distribution of naphthalene between commercial resins and water-methanol solutions [IS-T-802] N78-31193
Use of a semiconductor laser in infrared spectroscopy [IS-T-786] N78-31196
**ANALYTICAL AND COMPUTATIONAL MATHEMATICS, ZURICH [SWITZERLAND].**
Astrometry satellite. Theoretical study of the accuracy. Volume 1: Models and algorithms [ESA-CR[P]-1068-VOL-1] N78-32024
**APPLICATIONS MATHEMATIQUES ET LOGICIEL [AML] SARL, NEUILLY-SUR-SEINE [FRANCE].**
Astrometry satellite. Theoretical study of the accuracy. Volume 1: Models and algorithms [ESA-CR[P]-1068-VOL-1] N78-32024
Astrometry satellite. Theoretical study of the accuracy. Volume 2: Numerical experiments [ESA-CR[P]-1068-VOL-2] N78-32025
**APPLIED DEVICES CORP., KISSIMMEE, FLA.**
A modular adaptive, variable function flight control sensor [AD-A055175] N78-31120
**ARGONNE NATIONAL LAB., ILL.**
Magnetic susceptibility of AnRe2 compounds [CONF-771127-15] N78-31195
Microscopic theory of charge density wave instability in NbSe2 [CONF-7709106-1] N78-31197
**ARINC RESEARCH CORP., ANNAPOLIS, MD.**
Program analyses for the S-3 weapon system improvement program [AD-A055887] N78-31093
Experimental test plan for the evaluation of aircraft separation assurance displays using airline flight simulators [AD-A055849] N78-31134
**ARIZONA STATE UNIV., TEMPE.**
Cobalt as an analogue for iron in high temperature experiments on basaltic compositions N78-31629
**ARIZONA UNIV., TUCSON.**
Dedicated computer control of chemical instrumentation [AD-A055268] N78-31190
Fundamental stochastic models of the transport of water and solutes through saturated and unsaturated porous media [PB-279772/8] N78-31519
HISS: An approach to hierarchical system sharing for laboratory computers [AD-A055152] N78-31769
Singular perturbations of semilinear second order systems [AD-A055279] N78-31837
Blackbody simulator cavity radiation theory N78-31893
**ARMY AEROMEDICAL RESEARCH LAB., FORT RUCKER, ALA.**
Visual workload of the copilot/navigator during terrain flight [AD-A055038] N78-31742
Methodological considerations of visual workloads of helicopter pilots N78-31747
Use of Inspiratory Minute Volumes in evaluation of rotary and fixed wing pilot workload N78-31754
**ARMY AGENCY FOR AVIATION SAFETY, FORT RUCKER, ALA.**
Antitorque training: Evaluation of effectiveness in reducing mishap losses [AD-A055040] N78-31092
**ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND, ABERDEEN PROVING GROUND, MD.**
Aeroballistics of corkscrew projectiles [AD-A054735] N78-31049
Impact thresholds for the initiation of metal sparking [AD-A054738] N78-31189
INTERPOL: An interactive plotting package for off-line Cal Comp systems [AD-A054762] N78-31800
**ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND, DOVER, N. J.**
Three-beacon projectile guidance study [AD-A055992] N78-31151
Engineering feasibility study for elimination of nitroglycerin from solvent vapors [AD-A055980] N78-31192
Feasibility of using fluorescent materials in product assurance applications and for locating adhesive bond fractures [AD-A055979] N78-31245
Determination of minimum non-propagation distance of aluminum buckets containing 15 pounds of composition A5 [AD-A054737] N78-31259
Critical depth tests of bulk TNT flake explosive [AD-A054739] N78-31260
Investigation of propellant and explosive solid solution systems II X-ray studies [AD-A055981] N78-31263
Propellant reassessment program [AD-A055976] N78-31264
**ARMY AVIATION ENGINEERING FLIGHT ACTIVITY, EDWARDS AFB, CALIF.**
Modified helicopter icing spray system evaluation [AD-A055039] N78-31091
**ARMY AVIATION RESEARCH AND DEVELOPMENT COMMAND, ST. LOUIS, MO.**
Computerized aircraft attrition program [AD-A055784] N78-31094
**ARMY COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, N. H.**
Computer processing of LANDSAT digital data and sensor interface development for use in New England reservoir management [AD-A055762] N78-31513
Bearing capacity of river ice for vehicles [AD-A055244] N78-31637
A comparison between derived internal dielectric properties and radio-echo sounding records of the ice sheet at Cape Folger, Antarctica [AD-A055245] N78-31638
The compression of wet snow [AD-A055246] N78-31639
Segregation freezing as the cause of suction force for ice lens formation [AD-A055780] N78-31647
**ARMY CONCEPTS ANALYSIS AGENCY, BETHESDA, MD.**
A computer program for fitting censored samples to a Weibull distribution [CENWEIR] [AD-A054833] N78-31856
**ARMY CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, ILL.**
Hypothetical case studies of operational changes to reduce noise levels [AD-A055066] N78-31878
**ARMY ELECTRONICS COMMAND, FORT MONMOUTH, N. J.**
Applications of a charge coupled device sensor for Nap-of-the-Earth helicopter operations N78-31305
**ARMY ELECTRONICS TECHNOLOGY AND DEVICES LAB., FORT MONMOUTH, N. J.**
Alternate power sources session: Nuclear battery hybrid configuration study [AD-A055182] N78-31546
**ARMY ENGINEER DISTRICT, ROCK ISLAND, ILL.**
Proposed issuance of a new source National Pollutant Discharge Elimination System Permit No. IA-0060909 to Iowa Southern utilities company, Ottumwa generating station for discharge of wastewaters to the Des Moines River near Ottumwa, Iowa [PB-280369/0] N78-31617
**ARMY ENGINEER TOPOGRAPHIC LABS., FORT BELVOIR, VA.**
Review of photosensitive materials for holographic recordings [AD-A055013] N78-31407
**ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISS.**
State-of-the-art for assessing earthquake hazards in the United States. Report 9: Catalogues of strong motion earthquake records. Volume 1: Western United States, 1933-1971 [AD-A055971] N78-31645
**ARMY ENVIRONMENTAL HYGIENE AGENCY, ABERDEEN PROVING GROUND, MD.**
Toxicological evaluation of Pyrethrins Fogging Concentrate [trade name] study No. 51-1309-78 [AD-A055088] N78-31715
Hazard analysis of broad-band optical sources [AD-A054802] N78-31900
**ARMY MATERIALS AND MECHANICS RESEARCH CENTER, WATERTOWN, MASS.**
Solidification of electroslag remelted low alloy steel ingots [AD-A055576] N78-31221
**ARMY MISSILE RESEARCH AND DEVELOPMENT COMMAND, REDSTONE ARSENAL, ALA.**
Compilation of data relevant to rare gas-rare gas and rare gas-monohalide excimer lasers, volume 1 [AD-A053827] N78-31414
Computer software for analysis of infrared targets and clutter [AD-A054235] N78-31796
**ARMY RESEARCH AND TECHNOLOGY LABS., FORT EUSTIS, VA.**
Heat transfer modeling and analytical quenching of a powder metallurgy turbine disk during heat treatment [AD-A054022] N78-31110
**ARO, INC., ARNOLD AIR FORCE STATION, TENN.**
Results of a wind tunnel and flight test program to develop a Maximum Volume Bomb [MVB configuration for multiple carriage and separation from tactical-aircraft at mach numbers from 0.50 to 1.10 [AD-A055029] N78-31051
**ATLANTIC RICHFIELD HANFORD CO., RICHLAND, WASH.**
Determination of low-level mercury by cold vapor generation and atomic absorption spectroscopy [ARH-LD-160] N78-31203
**ATMOSPHERIC SCIENCES LAB., WHITE SANDS MISSILE RANGE, N. MEX.**
Atmospheric conditions at the High Energy Laser Systems Test Facility [HELSTF], White Sands Missile Range, New Mexico 24 March to 8 April 1977 [AD-A055028] N78-31671
**ATOMICS INTERNATIONAL DIV., RICHLAND, WASH.**
Risk analysis in environmental studies. 1: Risk analysis methodology, a statistical approach. 2: Data management for environmental studies [RHO-SA-33] N78-31597
**AUBURN UNIV., ALA.**
Effects of water-treatment-plant wastes on domestic wastewater treatment processes [PB-280970/5] N78-31968
**AUERBACH ASSOCIATES, INC., PHILADELPHIA, PA.**
Nitrosamines [PB-280479/7] N78-31727
Strong sensitizers [PB-280475/5] N78-31728

## B

**BARI UNIV. [ITALY].**
Reliability in the design of welded structures N78-31438
An interactive program for the analysis of fatigue data N78-31476
**BASEL UNIV. [SWITZERLAND].**
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 1: Selected areas 51, 54, 57, 82, 107 N78-32021
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 2: Selected areas 71, 94, 141; M3, M13, NGC4147 N78-32022
Photometric catalogue for stars in selected areas and other fields in the RGU-system. Volume 3: Milky way fields Perseus 1, NGC 1664, M 37 1, M 37 2, NGC 6067, Sagittarius 1 N78-32023
**BATTELLE COLUMBUS LABS., OHIO.**
Study of heat transfer through refractory lined gasifier vessel walls [FE-2210-18] N78-31385
Organic characterization of aerosols and vapor phase compounds in urban atmospheres [PB-280050/6] N78-31611
**BATTELLE MEMORIAL INST., COLUMBUS, OHIO.**
Crack tip plasticity in dynamic fracture mechanics [AD-A055159] N78-31470
**BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WASH.**
Thermal performance measurements on ultimate heat sinks: Cooling ponds [NUREG/CR-0008] N78-31394
**BECHTEL CORP., SAN FRANCISCO, CALIF.**
Flue gas desulfurization systems: Design and operating considerations. Volume 1: Executive summary [PB-280253/6] N78-31598
Flue gas desulfurization systems: Design and operating considerations. Volume 2: Technical report [PB-280254/4] N78-31599
**BELL AND HOWELL CO., CHICAGO, ILL.**
Boron trifluoride coatings for thermoplastic materials and method of applying same in glow discharge [NASA-CASE-ARC-11057-1] N78-31233
**BELL-NORTHERN RESEARCH LTD., OTTAWA (ONTARIO).**
A wide bandwidth CCD buffer memory system N78-31291
A microprocessor controlled electrically programmable transversal filter N78-31292
A high performance CCD Linear Imaging Array N78-31310
**BELL TELEPHONE LABS., INC., MURRAY HILL, N. J.**
Detection of 511 keV positron annihilation radiation from the galactic center direction N78-31978

**BENDIX CORP., KANSAS CITY, MO.**
Syntactic foam from silver coated microbubbles
[BDX-613-1790-REV] N78-31247
Investigation of methylpentene polymer [CPX] molding resin
[BDX-613-1905-REV] N78-31248
Material evaluation of polyurethane foam, 0.05 g/cm3 density
[BDX-613-1836-REV] N78-31249
Mechanical properties of 0.2 g/cm-3 polystyrene bead foam
[BDX-613-1725-REV] N78-31250
Development of plating thickness standards
[BDX-613-1709-REV] N78-31272

**BLACK AND VEATCH CONSULTING ENGINEERS, KANSAS CITY, MO.**
Proposed issuance of a new source National Pollutant Discharge Elimination System Permit No. IA-0060909 to Iowa Southern utilities company, Ottumwa generating station for discharge of wastewaters to the Des Moines River near Ottumwa, Iowa
[PB-280369/0] N78-31617

**BOEING CO., SEATTLE, WASH.**
Applications of thermal energy storage to process heat storage and recovery in the paper and pulp industry
[NASA-CR-159398] N78-31537

**BOEING VERTOL CO., PHILADELPHIA, PA.**
Helicopter transmission vibration and noise reduction program. Volume 1: Technical report
[AD-A055104] N78-31089
Engine/airframe/drive train dynamic interface documentation
[AD-A055766] N78-31114

**BOLT, BERANEK, AND NEWMAN, INC., CAMBRIDGE, MASS.**
On the epistemological status of semantic networks
[AD-A055048] N78-31337
Speech compression and evaluation
[AD-A055019] N78-31338
A formal approach to discourse anaphora
[AD-A055671] N78-31810

**BRITISH AIRCRAFT CORP. [OPERATING] LTD., BRISTOL [ENGLAND].**
Definition study of a multidisciplinary European mission. Volume 1: Executive summary
[ESS/SS-777] N78-31138
Study of attitude control systems using the earth's magnetic field at synchronous altitudes
[ESS/SS-834] N78-31154

**BROOKHAVEN NATIONAL LAB., UPTON, N. Y.**
Correlation of low-cycle and high-cycle fatigue data for solution-annealed Incoloy-800
[BNL-NUREG-23776] N78-31222
Outdoor sources of indoor air pollution
[BNL-50762] N78-31595
Hazards of organic working fluids
[BNL-50761] N78-31725

**BROWN UNIV., PROVIDENCE, R. I.**
Continuing crack tip deformation and fracture for plane-strain crack growth in elastic-plastic solids
[COO-3084-56] N78-31472

**BUREAU OF MINES, SPOKANE, WASH.**
Instrument to measure the initial deformation of rock around underground openings
[PB-279657/1] N78-31659

## C

**CALIFORNIA INST. OF TECH., PASADENA.**
Streak camera time calibration procedures
[NASA-CR-157573] N78-31403
Combustion dynamic processes associated with chemical advanced lasing systems
[AD-A055659] N78-31420
Study of magma sources, mantle structure and the differentiation of the earth from variations of Nd-143/Nd-144 in igneous rocks
N78-31630

**CALIFORNIA UNIV., BERKELEY.**
Transition metal ion binding by ferritin as studies by electron paramagnetic resonance spectroscopy
N78-31184
Mechanical stability of retained austenite in tempered 9Ni steel
[AD-A055240] N78-31217
Microstructure and magnetic properties of Fe-Cr-Co-V alloys
[LBL-6931] N78-31225
Strain induced plastic-to-rubber transition of an SBS block copolymer and its blend with PS
[AD-A055905] N78-31246
Deflection of a transversely loaded spinning disk
N78-31455
Telluric and D. C. resistivity techniques applied to the geophysical investigation of basin and range geothermal systems
N78-31627
The effect of high altitude on pyridine nucleotides and adenosine phosphates in the liver of the rat
N78-31689
Design and implementation of an adaptable compiler for minicomputer type architecture
N78-31761
Specification of reliable large-scale software systems
N78-31786
A machine independent algorithm for code generation and its use in retargetable compilers
N78-31789
Measures on the integers and limit distributions of additive, number-theoretic functions
N78-31848
Stability and multicriteria optimization
N78-31862
Optical difference frequency generation of far infrared radiation
N78-31895
Optical rotary saturation
N78-31896
Raman sidescatter instability in a nonuniform plasma
N78-31902
Nucleation phenomena in the formation electron-hole drops in Ge
N78-31910
Electron spectroscopy and low-energy electron diffraction studies of silicon and titanium oxide surfaces
N78-31915
On thermodynamics and the nature of the second law for mixtures of interacting continua
[AD-A055102] N78-31940
Control of access to shared information
N78-31948

**CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.**
Numerical analysis of flow fields generated by accelerating flames
[LBL-7233] N78-31199
Ductile superconducting wire through novel metallurgical techniques
[LBL-7366] N78-31227
On the complexity of grammar and language problems
N78-31782
Pionic instabilities in high-energy heavy ion collisions
[LBL-6525] N78-31882
Vibrational relaxation and energy transfer of matrix isolated HCl and DCl
[LBL-7344] N78-31885
Quantizing the polarization of lead zirconate-titanate
[LBL-7322] N78-31937
Multiperipheral ring dynamics and a definition of the complete twisted Reggeon loop
[LBL-6199] N78-31938
Radiation damage of germanium detectors
N78-32002

**CALIFORNIA UNIV., DAVIS.**
Engineering and pedological properties of soils as they affect soil erodibility
[PB-279856/9] N78-31658

**CALIFORNIA UNIV., IRVINE.**
Mechanisms of exhaust pollutants and plume formation in continuous combustion
[AD-A054844] N78-31594
Decompilation
N78-31759

**CALIFORNIA UNIV., LIVERMORE. LAWRENCE LIVERMORE LAB.**
Equation of state of vanadium
[UCID-17696] N78-31226
Characterizing high-energy-formed particulates with the scanning electron microscope/energy dispersive spectrometer system
[UCID-17652] N78-31266
Marx bank and magnetron circuit model
[UCID-17747] N78-31371
Certain characteristics of the stabilization system of a gamma-ray spectrometer with a light-emitting diode as the source of the reference signal
[UCRL-TRANS-11330] N78-31411
Injection locked, unstable resonator KrF discharge laser with linewidth of 3 GHz
[UCRL-80495] N78-31421
Forbidden transition selenium atom photodissociation lasers
[UCRL-80490] N78-31422
Fundamental study of crack initiation and propagation
[UCRL-80478] N78-31474
Measuring and predicting the dynamic effects of a confined thin metal plate pulse heated into the liquid-vapor regime
[UCRL-52375] N78-31475
High performance metal/air fuel cells. Part 1: General review
[UCID-17558-PT-1] N78-31549
Development of a three-dimensional model of the atmospheric boundary layer using the finite element method
[UCRL-52366] N78-31652
Design and construction of the Donner 280-crystal positron ring for dynamic transverse section emission imaging
[LBL-5679] N78-31721
Algebraic simplification of interconnected systems
[UCID-17760] N78-31843

**CALIFORNIA UNIV., LOS ANGELES.**
Optimization and estimation in nonlinear systems with application to inertial guidance
N78-31139
Structure and dynamics of organic materials under high pressure
N78-31167
Multiheteromacrocycles that complex metal ions
[SAN-34P218X4] N78-31194
MCP glass analysis studies
[AD-A055251] N78-31242
Probability intervals for the reliability of complex systems using Monte Carlo simulation
[PB-280191/8] N78-31449
An M/M/1 dynamic priority queue with optional promotion
N78-31824
Scheme-independent stability criteria for difference approximations of hyperbolic initial-boundary value problems, I
[AD-A055022] N78-31839

**CALIFORNIA UNIV., RIVERSIDE.**
A search for charmed meson production in proton-proton collisions at the CERN-ISR
N78-31887
Search for broad gamma ray lines with the UCR double Compton scatter telescope
N78-31981

**CALIFORNIA UNIV., SAN DIEGO.**
The reduction of molecular nitrogen, organic substrates and protons by vanadium[II]
N78-31181
Alfven/ion cyclotron waves and the ion cyclotron instability in the earth's magnetosphere
N78-31628
HEAO-1 observations of Her X-1 at energies above 13 keV
N78-31994

**CALMAC MFG. CO., ENGLEWOOD, N. J.**
Design and installation package for the Sunmat Flat Plate solar collector
[NASA-CR-150741] N78-31536

**CALSPAN CORP., BUFFALO, N. Y.**
Array scanning techniques
[AD-A055176] N78-31359

**CARLETON UNIV., OTTAWA [ONTARIO].**
Electro-optical processing of signals and images
N78-31308

**CARNEGIE-MELLON UNIV., PITTSBURGH, PA.**
Mechanical theorem proving and artificial intelligence languages
N78-31781
An annotated bibliography of natural language and speech understanding systems
[AD-A055863] N78-31808

**CASE WESTERN RESERVE UNIV., CLEVELAND, OHIO.**
Infrared studies of the solid state polymerization of diacetylene monomers
[AD-A055988] N78-31244

**CENTRAL TREATY ORGANIZATION, ANKARA [TURKEY].**
Regional investigations of tectonic and igneous geology, Iran, Pakistan, and Turkey
[E78-10197] N78-31495

**CENTRE D'ETUDE SPATIALE DES RAYONNEMENTS, TOULOUSE [FRANCE].**
A hard X-ray and gamma ray observation of the 22 November 1977 solar flare
N78-31974

**CHARLES RIVER ASSOCIATES, INC., CAMBRIDGE, MASS.**
Integrating policy analysis: Study module 7. Volume 2: Technical appendix
[PB-280037/3] N78-31587

**CHESAPEAKE RESEARCH CONSORTIUM, INC., BALTIMORE, MD.**
Proceedings of the Bi-state Conference on the Chesapeake Bay
[PB-282155/1] N78-31626

**CHICAGO UNIV., ILL.**
On the multiplicity of solutions of the inverse problem for a vibrating beam
[NASA-CR-157572] N78-31466
Social opportunity cost of capital: Empirical estimates
[ANL-SPG-2] N78-31955
Gamma line radiation from supernovae
N78-31988

**CINCINNATI UNIV., OHIO.**
Proceedings of AFOSR/AFML Corrosion Workshop
[AD-A055281] N78-31218

**CITY UNIV. OF NEW YORK.**
Monthly mean simulation experiments with a course-mesh global atmospheric model
[NASA-CR-157574] N78-31662

**CIVIL AEROMEDICAL INST., OKLAHOMA CITY, OKLA.**
GPSS computer simulation of aircraft passenger emergency evacuations
[AD-A056098] N78-31062

**CLARKSON COLL. OF TECHNOLOGY, POTSDAM, N.Y.**
Comparison of soil moduli obtained from non-destruction dynamic testing and constitutive equations
[AD-A055670] N78-31649
**COAST GUARD, WASHINGTON, D.C.**
Inflatable liferaft tests in the Pacific Ocean of the Columbia River Bar
[AD-A055323] N78-31065
**COLLEGE OF WILLIAM AND MARY, WILLIAMSBURG, VA.**
Effects of pressure anisotropy on the stability of the guiding center plasma
[ORO-5260-1] N78-31907
**COLORADO STATE UNIV., FORT COLLINS.**
Design definition study of the Earth radiation budget satellite system
[NASA-CR-158934] N78-31140
Thermal stratification enhancement for solar energy applications
[AD-A055918] N78-31547
**COLUMBIA UNIV., NEW YORK.**
Gamma ray polarimetry
[CONTRIB-156] N78-32004
**COMMISSARIAT A L'ENERGIE ATOMIQUE, SACLAY [FRANCE].**
Gamma ray astronomy and the origin of the light nuclei
N78-31986
Confidence about line features in Her X-1 spectrum
N78-31992
**COMMISSION OF THE EUROPEAN COMMUNITIES, ISPRA [ITALY].**
AGRESTE project: Agricultural resources investigations in northern Italy and southern France
[E78-10199] N78-31497
**COMMITTEE ON APPROPRIATIONS [U. S. SENATE].**
Department of Housing and Urban Development, and certain independent agencies appropriations for fiscal year 1979, part 2
[GPO-23-600] N78-31956
**COMMITTEE ON SCIENCE AND TECHNOLOGY [U. S. HOUSE].**
Future needs and opportunities in the air traffic control system
[GPO-98-931] N78-31076
International space activities
[GPO-30-920] N78-31137
Briefing on Department of Energy
[GPO-20-083] N78-31542
Environamental challenges of the President's energy plan: Implications for research and development
[GPO-96-834] N78-31543
Weather modification
[GPO-20-025] N78-31666
National climate program
[GPO-92-323] N78-31670
Astronauts and cosmonauts biographical and statistical data, revised 31 May 1978
[GPO-30-531] N78-32035
**COMPAGNIE GENERALE DE TELEGRAPHIE SANS FIL, PARIS [FRANCE].**
Convolution and correlation memory by means of surface acoustic wave devices
N78-31297
Reading and acoustic processing of optical images
N78-31304
**COMPUTER SCIENCES CORP., HUNTSVILLE, ALA.**
HOL code generator development methodology
[AD-A055383] N78-31804
**CONNECTICUT UNIV., STORRS.**
Two-crystal soft X-ray spectrometer
N78-31402
Computation expressions and their applications in an adaptive computer system
N78-31814
**CORNELL UNIV., ITHACA, N. Y.**
Direct observation of grain boundary diffusion by scanning Auger microscopy
[COO-2679-14] N78-31935
**CORY LABS., INC., ESCONDIDO, CALIF.**
Engineering design data and correlations for nitinol devices
N78-31206

## D

**DANISH RESEARCH CENTER FOR APPLIED ELECTRONICS, HOERSHOLM.**
Study of hybrid power structures
[ESA-CR[P]-1075] N78-31375
**DAUGHERTY [J. K.], DURHAM, N. C.**
Cyclotron emission in neutron star magnetospheres
N78-31995
**DAYTON UNIV., OHIO.**
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 1
[NASA-CR-135416-VOL-1] N78-31141
Continuation of the compendium of applications technology satellite and communications technology satellite user experiments 1967-1977, volume 2
[NASA-CR-135416-VOL-2] N78-31142
**DAYTON UNIV. RESEARCH INST., OHIO.**
Synergistic mechanisms of solid lubricants
[AD-A054741] N78-31243
**DEFENCE AND CIVIL INST. OF ENVIRONMENTAL MEDICINE, DOWNSVIEW [ONTARIO].**
Instruments and methodology for the assessment of physiological cost of performance of stressful continuous operations: The air traffic services tower environment
N78-31752
**DEFENSE INTELLIGENCE AGENCY, WASHINGTON, D.C.**
Hydrogen technology, foreign
[AD-A055024] N78-31261
**DELFT HYDRAULICS LAB. [NETHERLANDS].**
Discharge measurement structures
[PUBL-161] N78-31395
Flow-induced gate vibrations: Prevention of self-excitation. Computation of dynamic gate behaviour and the use of models
[PUBL-164] N78-31396
**DEPARTMENT OF ENERGY, WASHINGTON, D. C.**
Survey and analysis of selected topics within the Energy Research and Development Administration's [ERDA] materials research and development programs
[DOE/ET-0006] N78-31170
Alloys for the fusion reactor environment: A technical assessment
[DOE/ET-0007] N78-31908
Preliminary findings and views concerning the exemption of aviation gasoline from the mandatory petroleum allocation and price regulations
[DOE/ERA-0001] N78-31957
Preliminary findings and views concerning the exemption of kerojet fuels from the mandatory petroleum allocation and price regulations
[DOE/ERA-0002] N78-31958
**DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA [ONTARIO].**
Retransmission of hydrometric data in Canada
[E78-10204] N78-31502
**DEPARTMENT OF LABOR, WASHINGTON, D.C.**
Bias in the estimates of treatment effects in quasi-experimental evaluations
[PB-280060/5] N78-31861
**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, BERLIN [WEST GERMANY].**
Noise generation and noise propagation in centrifugal fans
[DLR-IB-257-78/1] N78-31879
**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, BRUNSWICK [WEST GERMANY].**
Investigations of a highly loaded compressor cascade with a control of the blade boundary layer. Part 5: Experimental investigations on the cascade with slotted blades
[DLR-IB-151-77/14] N78-31056
The determination of the Laval nozzle exit conditions at too high counterpressure, especially for a propane oxygen gas generator
[DLR-FB-77-45] N78-31057
Some important results obtained in the analysis of near midair and midair collisions
[DLR-FB-77-25] N78-31081
Flame stabilization in a ramjet combustion chamber by means of a pilot gas generator
[DLR-FB-77-54] N78-31117
The use of ram rockets for high altitude missiles
[DLR-FB-77-47] N78-31153
The influence of the environment on the elastoplastic properties of adhesives in metal bonded joints
[DLR-FB-77-63] N78-31251
Investigations of self organizing control laws and possibilities of their realization
[DLR-FB-77-57] N78-31833
**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, COLOGNE [WEST GERMANY].**
Pressure distribution in an open cavity at linear increasing external pressure
[DLR-FB-77-53] N78-31400
Additional thermal cycling tests on solar cell panel samples under vacuum conditions
[DLR-IB-353-78/1] N78-31585
Investigation of phase equilibria of TaC fiber reinforced cobalt alloys having a directionally solidified eutectic structure aimed at matrix hardening
[DLR-FB-77-58] N78-31939
**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, GOETTINGEN [WEST GERMANY].**
Molecular two-dimensional flow of mixtures of light and heavy gases with diffuse and specular reflection
[DLR-FB-77-51] N78-31060
Investigations on unsteady pressure distribution measurements in rotating systems
[DLR-FB-77-43] N78-31135
**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, LAMPOLDSHAUSEN [WEST GERMANY].**
Hot gas side heat transfer coefficients in high energy rocket engines with thrust variation
[DLR-FB-77-42] N78-31165
Energy losses in high energy rocket engines with thrust variation
[DLR-FB-77-41] N78-31166
**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, OBERPFAFFENHOFEN [WEST GERMANY].**
Control system design using vector-valued performance criteria with application to the control rate reduction in parameter insensitive control systems
[DLR-FB-77-55] N78-31125
Backus-Gilbert inversion of electromagnetic propagation phenomena for remote probing of the atmosphere
[DLR-IB-551-76/21] N78-31346
Synthetic Aperture Radar [SAR] system limitations due to phase errors
[DLR-IB-551-77/2] N78-31349
The coverage field of earth observation satellites at the earth surface. Description of the computer program COFI
[DLR-IB-552-77/40] N78-31516
Laboratory measurement of the solar remission factor g sub 1, 0 of the NO gamma band at 2147 A for the determination of the density of nitric oxide in the D-region of the ionosphere
[DLR-FB-77-30] N78-31653
New approximation equations for the saturation pressure of water vapor and for humidity parameters used in meteorology
[DLR-FB-77-52] N78-31679
Background storage management in operating systems for communication computers
[DLR-FB-77-37] N78-31821
Link invariant line programs in communication systems
[DLR-FB-77-38] N78-31822
Optical measurement of the radio interferometer of the DFVLR
[DLR-IB-551-77/13] N78-31901
**DORNIER-SYSTEM G.M.B.H., FRIEDRICHSHAFEN [WEST GERMANY].**
Evaluation of built-in stresses during manufacture of elements made of carbon fiber reinforced plastics
[ESA-CR[P]-1058] N78-31179
Design and development of a gas controlled heat pipe radiator for communication spacecraft application. Life test report
[ESA-CR[P]-1082] N78-31399
**DOUGLAS AIRCRAFT CO., INC., LONG BEACH, CALIF.**
Boundary-layer and inverse potential-flow methods for axisymmetric bodies
[AD-A054759] N78-31387
**DRAPER [CHARLES STARK] LAB., INC., CAMBRIDGE, MASS.**
A fault-tolerant multiprocessor architecture for aircraft, volume 1
[NASA-CR-3010] N78-31818
**DREXEL UNIV., PHILADELPHIA, PA.**
Double-exposure collector system
[TID-28291] N78-31576
Physical and chemical phenomena responsible for odor formation in diesel engines
[PB-280544/8] N78-31621
**DURHAM UNIV. [ENGLAND].**
Wall boundary layers in cascades
[ARC-CP-1388] N78-31058

## E

**EDGERTON, GERMESHAUSEN AND GRIER, INC., SALEM, MASS.**
Repetitive series interrupter 2
[AD-A055253] N78-31363
**EDINBURGH UNIV. [SCOTLAND].**
The design and development of CCD programmable transversal filters and correlators
N78-31289
**ENTROPY ENVIRONMENTALISTS, INC., RESEARCH TRIANGLE PARK, N.C.**
Regulations and resource file of continuous monitoring information
[PB-280975/4] N78-31625
**ENVIRONMENTAL MONITORING AND SUPPORT LAB., RESEARCH TRIANGLE PARK, N. C.**
Improved temperature stability of sulfur dioxide samples collected by the federal reference method
[PB-279873/4] N78-31610
**ENVIRONMENTAL PROTECTION AGENCY, KANSAS CITY, MO.**
Proposed issuance of a new source National Pollutant Discharge Elimination System Permit No. IA-0060909 to Iowa Southern utilities company, Ottumwa generating station for discharge of wastewaters to the Des Moines River near Ottumwa, Iowa
[PB-280369/0] N78-31617

**ENVIRONMENTAL PROTECTION AGENCY, RESEARCH TRIANGLE PARK, N.C.**
Air quality data: 1977 first quarter statistics
[PB-280184/3] N78-31600
Air quality data: 1977 second quarter statistics
[PB-280185/0] N78-31601
Air quality data: 1976 fourth quarter statistics
[PB-280186/8] N78-31602
Procedures for quantifying relationships between photochemical oxidants and precursors: Supporting documentation
[PB-280058/9] N78-31614
**ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, D. C.**
Water quality management guidance for mine-related pollution sources [new, current and abandoned]
[PB-280625/5] N78-31616
**ENVIRONMENTAL RESEARCH INST. OF MICHIGAN, ANN ARBOR.**
Analysis of scanner data for crop inventories
[E78-10207] N78-31505
**ESL, INC., SUNNYVALE, CALIF.**
Description of the MILSATCOM loading program OPAL
[AD-A054878] N78-31144
User's guide for the MILSATCOM loading program OPAL
[AD-A054879] N78-31145
Description of the MILSATCOM loading program OPAL, GPSCS addendum
[AD-A054880] N78-31146
User's guide for the MILSATCOM loading program OPAL, GPSCS addendum
[AD-A054881] N78-31147
**EUROPEAN SPACE RESEARCH AND TECHNOLOGY CENTER, NOORDWIJK [NETHERLANDS].**
Configuration management requirements
[ESA-SPEC-QRA-03-ISSUE-3] N78-31157
Standard parts list for ESA projects
[ESA-SPEC-QRC-04-ISSUE-1-REV-1] N78-31158
Evaluation and qualification of thick film hybrid microcircuits
[ESA-SPEC-QRC-06-ISSUE-2-REV-1] N78-31376

## F

**FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D. C.**
IFR aircraft handled forecast by air route traffic control center, fiscal years 1978-1989
[AD-A049305] N78-31075
**FIBER MATERIALS, INC., BIDDEFORD, MAINE.**
Fabrication of graphite-aluminum composites via pultrusion
[AD-A055257] N78-31173
**FLORIDA STATE UNIV., TALLAHASSEE.**
Climate simulation
[AD-A055857] N78-31672
Testing to determine the underlying distribution using randomly censored data
[AD-A054978] N78-31855
**FLORIDA UNIV., GAINESVILLE.**
Synthesis of thermally stable polymers
[NASA-CR-157360] N78-31234
Energy analysis of models of the United States N78-31555
Energy analysis of models of the United States, narrative N78-31556
Energy analysis of models of the United States, a summary of progress N78-31557
Energy analysis, energy quality, and environment N78-31558
Energy models of exchange with simulation of the role of exchange in spatial organization N78-31559
Efficiency and investment matching of high quality energy N78-31560
Energy diagrams of published energy analysis of others N78-31561
A meso-model of the economy of the United States for comparison of economic and energetic analysis N78-31562
Comparison of energy analysis of oil shale N78-31563
Energy analysis and models of soil formation N78-31564
Energy analysis of order-disorder phenomenon of man and nature N78-31565
Energy-quality calculations for freshwater chemical potential N78-31566
Energy quality of humidity and thermal advection of air in Florida N78-31567
A historic and current energy analysis of Florida N78-31568
Statistical test of energy models for prediction of urban growth in Florida N78-31569
Some aspects of energy use in housing N78-31570
Energy analysis and model of intermediate agriculture N78-31571
Energy analysis of Brazil N78-31572
Cypress wetlands for water management, recycling and conservation
[PB-282159/3] N78-31970
**FONDAZIONE UGO BORDONI, ROME [ITALY].**
Implementation of algorithms for performance analysis of a class of multiprogrammed computers
[FUB-25-1977] N78-31811
**FOREST PRODUCTS LAB., MADISON, WIS.**
Hardboard-webbed I-beams: Effects of long-term loading and loading environment
[AD-A055006] N78-31469
**FORSCHUNGSINSTITUT FUER FUNK UND MATHEMATIK, WERTHOVEN [WEST GERMANY].**
SAW filter application for phased array radar N78-31300
**FRANKLIN INST. RESEARCH LABS., PHILADELPHIA, PA.**
A literature review: Problem definition studies on selected toxic chemicals. Volume 6: Occupational health and safety and environmental aspects of urea-formaldehyde resins
[AD-A054991] N78-31716

## G

**GCA CORP., BEDFORD, MASS.**
Development and fabrication of a prototype Fibrous Aerosol Monitor [FAM]
[PB-280126/4] N78-31613
**GENERAL ACCOUNTING OFFICE, WASHINGTON, D. C.**
Status of the NAVSTAR global positioning system
[PB-280316/1] N78-31082
LANDSAT policy issues still unresolved
[PB-279701/7] N78-31517
Status of the Air Force's F-16 aircraft program
[PB-280304/7] N78-31946
Secondary treatment of municipal wastewater in the St. Louis Area - minimal impact expected
[PB-280965/5] N78-31969
**GENERAL ATOMIC CO., SAN DIEGO, CALIF.**
Quality assurance program document for 75 mW radioisotope thermoelectric generator program
[GA-A-14807] N78-31573
Analysis of nuclear systems satisfying US energy needs
[GA-A-14848] N78-31891
**GENERAL DYNAMICS/CONVAIR, SAN DIEGO, CALIF.**
Filling of orbital fluid management systems
[NASA-CR-159404] N78-31380
**GENERAL ELECTRIC CO., CINCINNATI, OHIO.**
Energy efficient engine: Preliminary design and integration studies
[NASA-CR-135444] N78-31108
Backup control for a variable cycle engine
[AD-A055658] N78-31116
Rolling element fatigue testing of gear materials
[NASA-CR-135411] N78-31427
**GENERAL ELECTRIC CO., LYNN, MASS.**
Turbine tip clearance measurement
[AD-A055765] N78-31115
**GENERAL ELECTRIC CO., PHILADELPHIA, PA.**
LANDSAT-1 and LANDSAT-2 flight evaluation report
[E78-10205] N78-31503
**GENERAL ELECTRIC CO., SANTA BARBARA, CALIF.**
Reaction rate data, number 61
[AD-A055983] N78-31644
**GENERAL ELECTRIC CO., SCHENECTADY, N. Y.**
Charge Injection Device [CID] Hadamard plane processor for image bandwidth compression N78-31309
Development and evaluation of an ultrasonic imaging system
[PB-279834/6] N78-31729
Research on aluminum nitride materials
[AD-A054980] N78-31930
**GENERAL ELECTRIC CO., SYRACUSE, N.Y.**
Impact of rock debris on a simply supported beam
[AD-A055077] N78-31467
**GENRAD, INC., CONCORD, MASS.**
Tracking servobridge detector, volume 1
[AD-A055083] N78-31356
Tracking servobridge detectors, volume 2
[AD-A055084] N78-31357
Tracking servobridge detectors. Volume 3: Operation sheets
[AD-A055085] N78-31358
**GEOLOGICAL SURVEY, DENVER, COLO.**
Method for obtaining confidence-limit values for seismic values calculated from Vibroseis data
[USGS-474-255] N78-31651
**GEOMETRICS, INC., SUNNYVALE, CALIF.**
Aerial gamma ray and magnetic survey, Van Horn and Pecos Quadrangles, Texas, volume 1
[GJBX-2-78-VOL-1] N78-31650
**GEOPHYSICAL OBSERVATORY, SODANKYLA [FINLAND].**
On the relative location of the plasmapause and the HF backscatter curtains
[REPT-23] N78-31636
**GEORGE WASHINGTON UNIV., WASHINGTON, D. C.**
Analyzing availability and readiness using transfer function models and cross spectral analysis
[AD-A055724] N78-31447
Exact fermat number transform convolution with comparison to fast Fourier transform techniques N78-31762
**GEORGETOWN UNIV., WASHINGTON, D.C.**
Piezoresistivity and its magnetic field dependence in N-type indium-antimonide N78-31914
**GEORGIA INST. OF TECH., ATLANTA.**
Cyclic ductility cyclic strength and fatigue crack propagation of metals and alloys
[AD-A055359] N78-31220
A laser scanner for 35mm film
[NASA-CR-150810] N78-31412
**GLOBE-UNION, INC., MILWAUKEE, WIS.**
Design and cost study for development of lead-acid batteries suitable for electric vehicle propulsion
[ANL-K-77-3624-1] N78-31548
**GREENFIELD, ATTAWAY AND TYLER, INC., SAN RAFAEL, CALIF.**
Nitrogen oxides: Current status of knowledge
[EPRI-EA-668] N78-31723
**GRENOBLE UNIV. [FRANCE].**
Review of methods for description of random transmission channels applications to identification and optimisation of detection and transmission processes
[CEPHAG-35/77] N78-31347
On the dual-adaptive control and its practical applications
[CEPHAG-52/77] N78-31832
Symmetry, automorphism and test
[CEPHAG-46/77] N78-31844
Diffusion of monoenergetic photoelectron fluxes inside the plasmasphere
[CEPHAG-39/77] N78-31909
**GRUMMAN AEROSPACE CORP., BETHPAGE, N.Y.**
An automated procedure for computing the three-dimensional transonic flow over wing-body combustions, including viscous effects. Volume 2: Program user's manual and code description. Appendix A: Computer code listing and flowchart
[AD-A055109] N78-31050
An automated procedure for computing the three-dimensional transonic flow over wing-body combinations, including viscous effects. Volume 1: Description of analysis methods and applications
[AD-A055899] N78-31052
Ground impingement of a fan jet exhaust plume
[AD-A054832] N78-31112
**GULF SOUTH RESEARCH INST., BATON ROUGE, LA.**
Coastal marsh productivity: A bibliography
[PB-281089/3] N78-31688

## H

**HANFORD ENGINEERING DEVELOPMENT LAB., RICHLAND, WASH.**
Three-dimensional inelastic analysis of a small liquid sodium valve
[HEDL-TME-77-91] N78-31435
Development of ultrasonic examination methods for austenitic stainless steel weld inspection
[HEDL-SA-1348] N78-31445
**HARRIS CORP., MELBOURNE, FLA.**
Broadband modem II
[AD-A055269] N78-31334
**HARVARD SCHOOL OF PUBLIC HEALTH, BOSTON, MASS.**
Physiological response to atmospheric pollutants
[PB-280413/6] N78-31731
**HAZARDS RESEARCH CORP., DENVILLE, N. J.**
Development of an explosive slurry monitor
[AD-A054736] N78-31258
**HEALTH EFFECTS RESEARCH LAB., RESEARCH TRIANGLE PARK, N. C.**
Air quality criteria for lead
[PB-280411/0] N78-31730
**HITTMAN ASSOCIATES, INC., COLUMBIA, MD.**
Operation Breakthrough site management systems and pneumatic trash collection, executive summary
[PB-280143/9] N78-31962
Evaluation of the refuse management system at the Jersey City operation breakthrough site
[PB-280551/3] N78-31965
**HOLT/PROCON, PASADENA, CALIF.**
Preliminary design manual for a geothermal demonstration plant at Herber, California
[EPRI-ER-670] N78-31575

HONEYWELL, INC., MINNEAPOLIS, MINN.
Solar heating and cooling systems design and development
[NASA-CR-150770] N78-31532
Solar Pilot Plant, phase 1: Preliminary design report. Volume 7: Pilot plant cost, commercial plant cost and performance, CDRL item 2
[SAN-1109-8/9-VOL-7] N78-31574
HONEYWELL CORPORATE MATERIAL SCIENCES CENTER, BLOOMINGTON, MINN.
Studies of indium-doped silicon
[AD-A054479] N78-31927
HOUSTON UNIV., TEX.
Linear feature selection with applications
[E78-10206] N78-31504
HUGHES AIRCRAFT CO., FULLERTON, CALIF.
UHF adaptive array development program
[AD-A055942] N78-31339
HUGHES AIRCRAFT CO., TORRANCE, CALIF.
Linear 1 kW multitone troposcatter TWT
[AD-A055667] N78-31370
HUGHES HELICOPTERS, CULVER CITY, CALIF.
Evaluation of a circulation control tail boom for yaw control
[AD-A055116] N78-31119
HUMAN ENGINEERING LABS., ABERDEEN PROVING GROUND, MD.
Use of eye-movement measures to establish design parameters for helicopter instrument panels
N78-31748
HUMAN RESOURCES RESEARCH ORGANIZATION, ALEXANDRIA, VA.
US Navy fleet aviation training program development
[AD-A055788] N78-31734
HUMBOLDT STATE COLL., ARCATA, CALIF.
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[ORNL-TM-6083] N78-31515
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[AD-A055286] N78-31048

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[AD-A055076] N78-31186
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[AD-A055283] N78-31362
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[AD-A055756] N78-31367
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[PB-280562/0] N78-31964
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[AD-A055937] N78-31408
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N78-31454
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N78-31456
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N78-31849
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N78-31917
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[COO-1198-1193] N78-31868
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[PB-279924/5] N78-31953
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[ORAE/IEA[R]-77-28] N78-31889
An acceptance nuclear fission future
[ORAU/IEA[M]-77-29] N78-31890
Toward an acceptable nuclear future
[ORAU/IEA[O]-77-31] N78-31892
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INPE LANDSAT system
[E78-10180] N78-31479
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[E78-10181] N78-31480
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[E78-10182] N78-31481
LANDSAT [MSS]: Image demographic estimations
[E78-10183] N78-31482
INPE's crop survey program using combined LANDSAT and aircraft data
[E78-10184] N78-31483
Geological mapping of regional drainage network in Brazil using LANDSAT images
[E78-10185] N78-31484
Use of LANDSAT data to identify and evaluate areas of sugar cane
[E78-10186] N78-31485
Evaluation of orbital images as a basis for land utilization
[E78-10187] N78-31486
Surface hydrodynamical models through synoptic interpretation of LANDSAT MSS images in lagoonal and coastal waters
[E78-10188] N78-31487
Use of LANDSAT imagery for soil survey
[E78-10189] N78-31488
Topographic studies through texture image analysis of LANDSAT data
[E78-10190] N78-31489
Collected summaries of works dealing with the application of LANDSAT imagery in the survey of mineral resources
[E78-10191] N78-31490
Use of LANDSAT data to monitor pasture project in Amazonia
[E78-10192] N78-31491
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[E78-10193] N78-31492
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[AD-A055754] N78-31118
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N78-31817

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JET PROPULSION LAB., CALIF. INST. OF TECH., PASADENA.
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[JPL-PUB-78-69] N78-31237
Nitramine propellants
[NASA-CASE-NPO-14103-1] N78-31255
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[NASA-CASE-NPO-14022-1] N78-31321
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[E78-10195] N78-31493
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A study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods, volume 2
[NASA-CR-157601] N78-31512
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[NASA-CASE-NPO-13581-2] N78-31525
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N78-31983
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N78-32000
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N78-32001
HEAO C-1 gamma-ray spectrometer
N78-32011
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N78-31695
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N78-31698
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N78-31699
The role of technological and lay-out factors, as well as climate, in formation of the air basin in the region of chemical plants
N78-31700
On the question of rapidly setting hygienic standards for industrial substances with irritant action
N78-31701
A variant of portable single-channel bioradiotelemetry system
N78-31702
A method of recording heat parameters of divers during work
N78-31703
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N78-31704
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N78-31706
Proliferation of bone marrow cells under the influence of superhigh intensity steady magnetic fields
N78-31707

Possibility of attenuating the ecological effects of alternating current power lines as a result of new designs and circuit changes
N78-31708
Magnet effects in biology
N78-31709

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KAISERSLAUTERN UNIV. [WEST GERMANY].
Combined acquisition and fine synchronization system for spread spectrum receivers using a tapped delay line correlator
N78-31319
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[LA-TR-77-52] N78-31265
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[LA-TR-78-23] N78-31410
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N78-31315
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Calibration and positional determination of Boller and Chivens 31-inch telescope B
[AD-A055266] N78-32020
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[PB-279910/4] N78-31204
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[AD-A055943] N78-31643
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N78-32010
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High-temperature shock initiation of explosives
[LA-7158] N78-31267
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[LA-TR-78-23] N78-31410
Hot dry rock, an alternate geothermal energy resource: A challenge for instrumentation
[LA-UR-78-707] N78-31553
Use of superconductive technology for energy storage and power transmission for large power systems: Power parks
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[LA-UR-78-681] N78-31724
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N78-31976
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N78-31977
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N78-31320
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[PB-280083/7] N78-31656
Magnetic fields in laser pellet plasmas
N78-31903
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N78-31904
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N78-32008
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[AD-A055384] N78-31389
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[AD-A054826] N78-31799
The discourse and reference components of PAL
[AD-A055046] N78-31801
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[AD-A055612] N78-31840
Variable metric methods and filtering theory
[AD-A055828] N78-31859
Analysis of a cooperative stereo algorithm
[AD-A055099] N78-31899
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[AD-A054756] N78-31906
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[AD-A055045] N78-31951
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N78-31985
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N78-31994
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[NASA-CR-157579] N78-31459
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N78-31183
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N78-31185
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[AD-A055078] N78-31270
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N78-31425
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N78-31815
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N78-31894
**MICROWAVE AND ELECTRONIC SYSTEMS LTD., NEWBRIDGE (SCOTLAND).**
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N78-31284
Development and application of a SAW Chirp-Z transformer
N78-31311
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N78-31711
**MISSION RESEARCH CORP., SANTA BARBARA, CALIF.**
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[AD-A055861] N78-31673
**MISSISSIPPI UNIV., UNIVERSITY.**
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[AD-A055989] N78-31262
**MISSOURI DEPT. OF NATURAL RESOURCES, ROLLA.**
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[E78-10209] N78-31507
**MISSOURI UNIV. - COLUMBIA.**
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[AD-A055649] N78-31124
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N78-31916
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[AD-A055482] N78-31130
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[AD-A056052] N78-31131
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[PB-279846/0] N78-31744
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**MONTANA STATE HIGHWAY DEPT., HELENA.**
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[PB-280578/6] N78-31520
**MONTANA STATE UNIV., MISSOULA.**
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N78-31912
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N78-31295

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[FE-1216-4] N78-31554
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N78-32003
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N78-32013
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N78-32015
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CALIF.**
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[NASA-CASE-ARC-11008-1] N78-31232
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[NASA-CASE-ARC-11057-1] N78-31233
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[NASA-SP-427] N78-31508
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[NASA-CASE-ARC-11058-1] N78-31735
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[NASA-TP-1255] N78-31739
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[NASA-TP-1315] N78-31413
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[NASA-CASE-GSC-11883-2] N78-31426
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[NASA-TM-79617] N78-31510
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[NASA-TM-79583] N78-31633
Gravitational spectra from direct measurements
[NASA-TM-79603] N78-31634
The utility of surface magnetic field measurements in the MAGSAT program
[NASA-TM-79614] N78-31635
The GISS sounding temperature impact test
[NASA-TM-78063] N78-31667
Some problems of Maryland towns as seen by their mayors
[NASA-TM-79618] N78-31960
Gamma ray spectroscopy in astrophysics
[NASA-TM-79619] N78-31971
Mechanisms and sites for astrophysical gamma ray line production
N78-31972
Gamma ray emission and solar flares
N78-31975
The galactic gamma-ray flux in the 0.06 to 5 MeV range
N78-31979
Nuclear gamma rays from compact objects
N78-31984
Galactic center iron line emission
N78-31987
Gamma ray lines from novae
N78-31989
Gamma-ray line emission above 8 MeV
N78-31990
Upper limits on the cyclotron lines from Her X-1 as observed with OSO-8
N78-31993
The excitation of electronic transverse energy levels in an intense magnetic field
N78-31996
The transfer of cyclotron lines through the magnetospheric shell of Hercules X-1
N78-31997
Measurements of 15.11-MeV gamma-ray flux produced in the reactions C-12[p, p']-C-12'[15.11 MeV] and O-16[p, p' alpha]-C-12'[15.11 MeV]
N78-32007
The ISEE-C gamma ray burst spectrometer
N78-32009
X-ray observations of BL Lac objects
[NASA-TM-79625] N78-32016
High energy X-ray spectra of cygnus XR-1 observed from OSO-8
[NASA-TM-79626] N78-32017
M2 ocean tide parameters and the deceleration of the moon's mean longitude from satellite orbit data
[NASA-TM-79571] N78-32028
Solar gamma rays above 8 MeV
[NASA-TM-79623] N78-32031
Gamma-ray evidence for a galactic halo
[NASA-TM-79570] N78-32034
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TEX.**
Multi-purpose wind tunnel reaction control model block
[NASA-CASE-MSC-19706-1] N78-31129
A pressure limiting propellant actuating system
[NASA-CASE-MSC-18179-1] N78-31162
Procedures for gathering ground truth information for a supervised approach to a computer implemented land cover classification of LANDSAT acquired multispectral scanner data
[E78-10198] N78-31496
The skylab S191 spectrometer experiment: Analysis of data and their applications to the earth sciences
[NASA-TM-58208] N78-31509
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. JOHN F. KENNEDY SPACE CENTER, COCOA BEACH, FLA.**
Simulation study of the power of the Kolmogoroff-Smirnoff and Z tests for the exponential distribution
[NASA-TP-1311] N78-31854
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, HAMPTON, VA.**
Control-surface hinge-moment calculations for a high-aspect-ratio supercritical wing
[NASA-TM-78664] N78-31043
Analysis of stability contributions of high dihedral V-tails
[NASA-TM-78729] N78-31044
Aerodynamic characteristics of a hypersonic research airplane concept having a 70 deg swept double-delta wing at Mach number 0.2
[NASA-TP-1252] N78-31045
Simulation and flight evaluation of a head-up landing aid for general aviation
[NASA-TP-1276] N78-31101
Demonstration of aircraft wing/store flutter suppression systems
N78-31128
Numerical procedure to determine geometric view factors for surfaces occluded by cylinders
[NASA-TM-78740] N78-31354
Measurement techniques and applications of charge transfer to aerospace research
[NASA-TM-78734] N78-31404
Displacement probes with self-contained exciting medium
[NASA-CASE-LAR-11690-1] N78-31406

An improved computational procedure for determining helicopter rotor blade natural modes
[NASA-TM-78670] N78-31792
SPAR data handling utilities
[NASA-TM-78701] N78-31793
An alternating direction implicit method for the Control Data STAR-100 vector computer
[NASA-TP-1282] N78-31836

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND, OHIO.
Simultaneous measurements of ozone outside and inside cabins of two B-747 airliners and a Gates Learjet business jet
[NASA-TM-78983] N78-31061
Gas path seal
[NASA-CASE-LEW-12131-2] N78-31103
Analysis of metal temperature and coolant flow with a thermal-barrier coating on a full-coverage-film-cooled turbine vane
[NASA-TP-1310] N78-31109
Nodding feed antenna for communications with satellites in sychronous orbit
[NASA-TM-78989] N78-31155
Liquid rocket engine axial-flow turbopumps
[NASA-SP-8125] N78-31164
Inhibition of hot salt corrosion by metallic additives
[NASA-TM-78966] N78-31208
Review of the AGARD S and M panel evaluation program of the NASA-Lewis SRP approach to high-temperature LCF life prediction
[NASA-TM-78879] N78-31209
The effect of fuel-to-air ratio on burner-rig hot corrosion
[NASA-TM-78960] N78-31210
Longitudinal shear behavior of several oxide dispersion strengthened alloys
[NASA-TM-78973] N78-31211
Effects of compositional changes on the performance of a thermal barrier coating system
[NASA-TM-78976] N78-31212
Effects of thermomechanical processing on strength and toughness of iron - 12-percent-nickel - reactive metal alloys at -196 C
[NASA-TP-1308] N78-31213
Effect of attrition milling on the reaction sintering of silicon nitride
[NASA-TM-78965] N78-31236
The 20/30 GHz satellite systems technology needs assessment
[NASA-TM-78975] N78-31323
Draining characteristics of hemispherically bottomed cylinders in a low-gravity environment
[NASA-TP-1297] N78-31384
Initial test results with a single-cylinder rhombic-drive Stirling engine
[NASA-TM-78919] N78-31533
Effect of inlet temperature on the performance of a catalytic reactor
[NASA-TM-78977] N78-31534
Digital enhancement of computerized axial tomograms
[NASA-TM-78974] N78-31690
Correlation of combustor acoustic power levels inferred from internal fluctuating pressure measurements
[NASA-TM-78986] N78-31871
Outline of cost-benefit analysis and a case study
[NASA-TM-78984] N78-31954
Spacecraft charging control by thermal, field emission with lanthanum-hexaboride emitters
[NASA-TM-78990] N78-32014

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.
Radiative and gas cooling of falling molten drops
[NASA-TM-78189] N78-31381
Evaluation of AAFE apparatus to measure residual and transient convection in zero-gravity
[NASA-TM-78191] N78-31382
Instruments for measuring the amount of moisture in the air
[NASA-TM-78190] N78-31405
Disposal of radioactive iodine in space
[NASA-TP-1313] N78-31740
Rice University observations of the galactic center
N78-31982

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. PASADENA OFFICE, CALIF.
Nitramine propellants
[NASA-CASE-NPO-14103-1] N78-31255
Reflex feed system for dual frequency antenna with frequency cutoff means
[NASA-CASE-NPO-14022-1] N78-31321
Solar pond
[NASA-CASE-NPO-13581-2] N78-31525
Non-tracking solar energy collector system
[NASA-CASE-NPO-13813-1] N78-31526
Coal desulfurization process
[NASA-CASE-NPO-13937-1] N78-31527

NATIONAL AEROSPACE LAB., AMSTERDAM [NETHERLANDS].
A simple finite-difference technique for the computation of threedimensional incompressible laminar boundary layers. Part 2: Description of the program
[NLR-TR-76086-U-PT-2] N78-31398
Environmental effects on fatigue of aluminium and titanium alloys
[NLR-MP-77019-U] N78-31463

NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N. J.
TRSB microwave landing system demonstration program at John F. Kennedy International Airport, Long Island, New York, USA
[AD-A055447] N78-31070
TRSB microwave landing system demonstration program at Kristiansand, Norway
[AD-A055317] N78-31071
TRSB microwave landing system demonstration program at Charleroi, Belgium
[AD-A055920] N78-31072
Dulles control tower console design study
[AD-A056200] N78-31132
Test and evaluation of air/ground communications antennas
[AD-A056148] N78-31325

NATIONAL BUREAU OF STANDARDS, BOULDER, COLO.
Summary of work on cooled ion frequency standard
[AD-A054234] N78-31880

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C.
Statistical model for random errors of position location based on lines of position
[PB-281158/6] N78-31079
The role of passive film growth kinetics and properties in stress corrosion and crevice corrosion susceptibility
[AD-A055366] N78-31219
Development of a data base for assessing plastic fire hazards
[PB-280027/4] N78-31254
Experimental determinations of temperatures and power losses at the electrical connections of some duplex receptacles
[PB-280071/2] N78-31378
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[PB-280114/0] N78-31444
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[PB-279921/1] N78-31823

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[ESA-ESTL-29] N78-31439

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[PB-280982/0] N78-31967

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[PB-281460/6] N78-31686

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Massachusetts coastal zone management program and final environmental impact statement
N78-31681

NATIONAL PHYSICAL LAB., TEDDINGTON [ENGLAND].
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[ESA-CR[P]-1063] N78-31348

NATIONAL SEVERE STORMS LAB., NORMAN, OKLA.
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[PB-281860/7] N78-31277
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[AD-A056151] N78-31669

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[PB-280795/6] N78-31589

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[NTIS/PS-78/0539/3] N78-31066
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[NTIS/PS-78/0527/8] N78-31274
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[NTIS/PS-78/0581/5] N78-31352
Integrated circuit reliability, volume 3. A bibliography with abstracts
[NTIS/PS-78/0579/9] N78-31377
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[NTIS/PS-78/0540/1] N78-31732
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[NTIS/PS-78/0609/4] N78-31773
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[NTIS/PS-78/0612/8] N78-31775
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[NTIS/PS-78/0615/1] N78-31778
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[NTIS/PS-78/0616/9] N78-31779
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[NTIS/PS-78/0605/2] N78-31947
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[NTIS/PS-78/0529/4] N78-31959

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[AD-A055325] N78-31941

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Is man the weakest link?
N78-31746

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[AD-A055672] N78-31098
The human operator simulator: Workload estimation using a simulated secondary task
N78-31756

Operator workload assessment model: An evaluation of a VF/VA-V/STOL system
N78-31757

NAVAL AIR ENGINEERING CENTER, LAKEHURST, N.J.
Safety analysis LOX-30 liquid oxygen generator
[AD-A054804] N78-31063

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Rotor burst protection program: Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1975
[NASA-CR-135304] N78-31105

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[AD-A054243] N78-31046

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[AD-A055258] N78-31331
Functional description of a validation tool for CMS-2 software
[AD-A055973] N78-31805

NAVAL POSTGRADUATE SCHOOL, MONTEREY, CALIF.
An experimental investigation of enhanced heat transfer on horizontal condenser tubes
[AD-A055430] N78-31392
Experimental investigation of the marine boundary layer in support of air pollution studies in the Los Angeles air basin
[AD-A054239] N78-31592

NAVAL RESEARCH LAB., WASHINGTON, D. C.
The steering problem for the mirror-scan tracking system. Part 1: The stop-go-stop procedure
[AD-A055125] N78-31336
UHF scintillation characteristics as observed from Keflavik, Iceland
[AD-A055760] N78-31344
Gamma ray spectroscopy in astrophysics: Future role of scintillation detectors
N78-31999

NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS, MD.
Transverse compressional damping in the vibratory response of elastic-viscoelastic-elastic beams
[AD-A054769] N78-31468

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Two-dimensional subsonic wind tunnel evaluation of two related cambered 15-percent thick circulation control airfoils
[AD-A055140] N78-31047
Rotating arm experiments for the stable semi-submerged platform [SSP] manuevering predictions
[AD-A055721] N78-31434
Feasibility study for incorporating a data structure definition and manipulation facility within the comrade data management system
[AD-A055097] N78-31765

NAVAL SURFACE WEAPONS CENTER, DAHLGREN, VA.
Theoretical and experimental methods in the solution of missile nonlinear roll problems
[AD-A055718] N78-31152
Navy Distributed Computer Systems Workshop
[AD-A055080] N78-31766

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Domain orientation in single crystal TbFe[2] and Tb[.27]Dy[.73]Fe[2]
[AD-A055025] N78-31931

NAVAL UNDERWATER SYSTEMS CENTER, NEWPORT, R. I.
Rotary expander engine development program
[AD-A055662] N78-31432

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Temperature dependence of the dielectric constant of quartz polyimide, part 2
[AD-A055105] N78-31239
Antimisting fuel spillage/airshear tests at Naval Weapons Center
[AD-A056113] N78-31256
Conversion of trash to gasoline
[AD-A055113] N78-31257
Display size and target acquisition perforance
[AD-A054624] N78-31741

NAVAL WEAPONS HANDLING LAB., COLTS NECK, N. J.
Dynamic analysis of shipping container suspension system for the canister launched version of the HARPOON missile RGM-84A-3A
[AD-A055719] N78-31433

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Evaluation program for secondary spacecraft cells
[NASA-CR-156812] N78-31540

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N78-31973

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N78-32012

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The development and application of new experimental laboratory techniques and equipment for measuring laser energy attenuation in the atmosphere
[AD-A055082] N78-31415

NORGES TEKNISKE HOEGSKOLE, TRONDHEIM.
Experiments and analysis of acoustoelectric memory correlators
N78-31296

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N78-31680

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Development of a computer program to calculate aerodynamic characteristics of bodies and wing-body combinations
[AD-A055846] N78-31053
Pavement design manual for secondary roads in North Carolina
[PB-280971/3] N78-31275

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N78-31834
Some path properties of p-TH order and symmetric stable processes
[AD-A055844] N78-31857

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[AD-A055101] N78-31168

NORTH CAROLINA UNIV., RALEIGH.
Development of a set of general rigid and flexible body equations of motion in coupled form using the direct approach
N78-31867

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Thermomechanical effects in sliding wear
[AD-A055318] N78-31431
Crack tip plasticity in dynamic fracture mechanics
[AD-A055159] N78-31470
Stochastic modelling of site wind characteristics
[RLO-2342-77/2] N78-31675

NOTRE DAME UNIV., IND.
Alternatives for jet engine control
[NASA-CR-157578] N78-31107

## O

OAK RIDGE NATIONAL LAB., TENN.
System for vacuum pouring of epoxy tensile and impact specimens with a study of the behavior of these specimens at 77 K and 293 K
[ORNL-TM-5493] N78-31178
Lithium compatibility research: Status and requirements for ferrous materials
[CONF-780308-6] N78-31224
Stress-strain behavior of ERNiCr-3 weld filler metal under strain controlled cyclic loading
[ORNL-TM-6128] N78-31228
Mechanical properties test data for structural materials
[ORNL-5380] N78-31473
WNDROS: A program for displaying wind rose data
[ORNL-CSD-TM-40] N78-31674
ORIS: The Oak Ridge Imaging System program listings
[ORNL-TM-5875-V3] N78-31722

OAKLAND UNIV., ROCHESTER, MICH.
An adaptive recognition algorithm for the automatic detection of straight line segments
N78-31787

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N78-31286

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[ESA-CR[P]-1069] N78-31180
Proton and electron irradiation of thermal control coatings and polymeric films. Part 1: Experimental part
[ESA-CR[P]-1077-VOL-1] N78-31252
Proton and electron irradiation of thermal control coatings and polymeric films. Part 2: Theoretical part
[ESA-CR[P]-1077-VOL-2] N78-31253

OHIO STATE UNIV., COLUMBUS.
Fundamental studies of metal fluorination reactions
[COO-2671-7] N78-31202
Hydrogen attack of steel
[COO-2872-2] N78-31223
A variable inertia flywheel as an energy storage system
N78-31529

Earth orientation from lunar laser range-differencing
[NASA-CR-157592] N78-32027

OHIO UNIV., ATHENS.
Computing LORAN time differences with an HP-25 hand calculator
[NASA-CR-157580] N78-31067
Phase-locked tracking loops for LORAN-C
[NASA-CR-157582] N78-31068
Loran-C flight test software
[NASA-CR-157581] N78-31069

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[EPRI-AF-528] N78-31552

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[ERG-022] N78-31268
Energy analysis and oil shale reserves
[ERG-023] N78-31584

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High output solar cell with multilayer AR coating
[AD-A054226] N78-31545

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Adaptive compensation techniques
[AD-A055177] N78-31828

OREGON STATE UNIV., CORVALLIS.
A new loop structure for distributed microcomputing systems
N78-31760

OREGON UNIV., EUGENE.
Electron scattering rate anisotropy and conduction electron-4f moment interactions Au[rare earth] dilute alloys
N78-31920

OREGON UNIV. HEALTH SCIENCES CENTER, PORTLAND.
Analytical study of electrophoretic characterization of kidney cells
[NASA-CR-150790] N78-31713
Electrical enhancement of healing in combat injuries to hard and soft tissues
[AD-A055531] N78-31718

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[AD-A055773] N78-31646
Measurement of 200-400 nm solar UV fluxes at altitudes up to 39 km on the Stratcom 7-A balloon flight
[AD-A055774] N78-32033

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
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[AD-A055260] N78-31271
Secondary flow vorticity in the passage of a rotor
[AD-A055388] N78-31391
Transient behavior of solid sensible heat thermal energy storage units
N78-31528
A study of weighted distributions and size-biased sampling
N78-31847
A robust class of tests and estimates for multivariate location based on ranks
N78-31852
Diffraction effects of baffles on acoustic directivity patterns
N78-31869
An acoustic field generated by subsonic jets at low Reynolds numbers
N78-31870
Piezo-optic properties of liquids under high pressure
N78-31898

PENNSYLVANIA UNIV., PHILADELPHIA.
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[NASA-CR-157571] N78-31714

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[PHL-1977-39] N78-31373

PLESSEY RADAR LTD., HAVANT [ENGLAND].
A CCD digital image store
N78-31306

PRATT AND WHITNEY AIRCRAFT GROUP, WEST PALM BEACH, FLA.
Advanced optical blade tip clearance measurement system
[NASA-CR-159402] N78-31106

Radiographic examination of T55 engine
[AD-A055108] N78-31113
TF30 third-stage composite fan blade service program
[AD-A055891] N78-31174
**PRINCETON UNIV., N. J.**
The influence of throttle augmented stability [APCS] and short period control characteristics on the landing approach
[AD-A055892] N78-31123
Optimum quantization for memoryless detection in M-dependent noise
[AD-A055174] N78-31768
Radiation effects on MOS/SOS semiconductor devices
[AD-A055925] N78-31934
**PROFESSIONAL STAFF ASSOCIATION OF LOS ANGELES COUNTY/-UNIV. OF SOUTHERN CALIFORNIA MEDICAL CENTER, LOS ANGELES.**
Behavior, ecology and toxicity of venomous marine fishes
[AD-A054925] N78-31692
**PURDUE UNIV., LAFAYETTE, IND.**
Effects of dynamic aeroelasticity on handling qualities and pilot rating
N78-31084
A Monte Carlo analysis of science instrument scan sequences for unmanned missions to the planets
N78-31136
Spectral and total emissivity and reflectivity at high temperatures
[AD-A055027] N78-31191
Space-time signal processing of radar returns
[AD-A055758] N78-31342
Analytical techniques for the study of some parameters of multispectral scanner systems for remote sensing
[E78-10200] N78-31498
Syntactic algorithms for image segmentation and a special computer architecture for image processing
N78-31785
Power comparisons of two-sided tests of equality of two covariance matrices and some distribution theory
N78-31851
Dynamics of incommensurate charge density waves in electric and magnetic fields
N78-31911
Brillouin scattering of reflected light by the bulk acoustic phonons in GaAs and CdS
N78-31923

## R

**RAND CORP., SANTA MONICA, CALIF.**
Estimated costs of extended low-rate airframe production
[AD-A054834] N78-31100
**RAYTHEON CO., BEDFORD, MASS.**
The Chirp Z transform with CCD and SAW technology
N78-31312
**RAYTHEON CO., WALTHAM, MASS.**
Electrical traps in microwave materials
[AD-A055086] N78-31928
**RAYTHEON CO., WAYLAND, MASS.**
Design, fabrication and testing of a CFA for use in the solar power satellite
[NASA-CR-159410] N78-31143
**RCA LABS., PRINCETON, N. J.**
Reproducible adhesion test for soldered thick-film conductors
[AD-A054971] N78-31361
**RENSSELAER POLYTECHNIC INST., TROY, N. Y.**
Plasticity and variable heredity
[AD-A054254] N78-31214
The constant volume hypothesis for the inelastic deformation of metals in the small strain range
[AD-A054253] N78-31215
A nonlinear uniaxial integral constitutive equation incorporative rate effects, creep, and relaxation
[AD-A054252] N78-31216
IRCCD imaging sensors: A review of device options
N78-31302
Adaptive Kalman type estimation applied to image processing
[AD-A055827] N78-31365
The 70 S monosome accumulation and in vitro initiation complex formation by Escherichia coli ribosomes at 5 C
[NASA-CR-157591] N78-31691
**RESEARCH CORP. OF NEW ENGLAND, WETHERSFIELD, CONN.**
Development of vertical dispersion coefficients for deep-valley terrain
[COO-4026-3] N78-31596
**RESEARCH INST. OF NATIONAL DEFENCE, STOCKHOLM [SWEDEN].**
Theoretical and experimental investigation of computation errors in two different strapdown inertial navigation [IN]-systems
[FOA-C-20217-E4] N78-31080
The capability of a network of seismological stations to detect events and to obtain identification parameters
[FOA-C-20231-T1] N78-31654
Seismic magnitude estimates, with a minimum number of detections
[FOA-C-20232-T1] N78-31655
Correlations between night vision tests
[FOA-C-56014-H9] N78-31726
**RESEARCH TRIANGLE INST., DURHAM, N. C.**
Nitrogen dioxide photolytic, radiometric, and meteorological field data
[PB-279999/7] N78-31604
Organic emissions from automobile interiors
[PB-280374/0] N78-31605
Identification of components of energy-related wastes and effluents
[PB-280203/1] N78-31606
**RESEARCH TRIANGLE INST., RESEARCH TRIANGLE PARK, N. C.**
AFAL simulation facility/capability manual. Volume I: Executive summary and Systems Avionics Division
[AD-A055591] N78-31102
Report of the 1977 National Survey of science, mathematics, and social studies education
[PB-280192/6] N78-31944
**RETICON CORP., SUNNYVALE, CALIF.**
CCPD: The optimum solid-state line scanner
N78-31303
**RHODE ISLAND UNIV., KINGSTON.**
Atmospheric pathways of the phosphorus cycle
N78-31590
Supplemental data report on investigations of marine dissolved organic matter protonation equilibria
[AD-A055157] N78-31682
**ROCHESTER UNIV., N. Y.**
MANOVA multiple comparisons associated with finite intersection tests
[AD-A055842] N78-31858
**ROCKWELL INTERNATIONAL CORP., ANAHEIM, CALIF.**
A hybrid SAW/CCD signal processor
N78-31290
**ROCKWELL INTERNATIONAL CORP., DOWNEY, CALIF.**
Multi-purpose wind tunnel reaction control model block
[NASA-CASE-MSC-19706-1] N78-31129
A pressure limiting propellant actuating system
[NASA-CASE-MSC-18179-1] N78-31162
**ROCKWELL INTERNATIONAL CORP., LOS ANGELES, CALIF.**
Hazard assessment of aircraft gun compartments
[AD-A055026] N78-31064
**ROCKWELL INTERNATIONAL SCIENCE CENTER, THOUSAND OAKS, CALIF.**
Structure of gain boundaries in silicon nitride based alloys
[LBL-6985] N78-31177
**ROME AIR DEVELOPMENT CENTER, GRIFFISS AFB, N.Y.**
Material choice for optimum SAW device performance
N78-31282
The monolithic integration of surface acoustic wave and semiconductor circuit elements on silicon for matched filter device development
N78-31295
**ROME AIR DEVELOPMENT CENTER, HANSCOM AFB, MASS.**
Systems applications of SAW filters and delay lines
N78-31294
**ROME UNIV. [ITALY].**
Off design performance of supercharged two stroke diesel engines
N78-31437
**ROYAL AIR FORCE INST. OF AVIATION MEDICINE, FARNBOROUGH [ENGLAND].**
Auditory communication and workload
N78-31749
Pitch and formant analysis of the voice in the investigation of pilot workshop
N78-31750
**ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH [ENGLAND].**
The design and aerodynamic characteristics of the RAE 5215 aerofoil
[ARC-CP-1386] N78-31055
Laminar flow-field computation in axisymmetric nozzles
[RAE-TR-77175] N78-31059
Technical evaluation of flying weapon systems
[RAE-LIB-TRANS-1948] N78-31087
Alternating tension-compression fatigue strength and property changes of steel after cold deformation at different deformation rates
[RAE-LIB-TRANS-1967] N78-31207
The vibrating environment in transport vehicles: A critical bibliographical study
[RAE-LIB-TRANS-1917] N78-31738
The development of quasi-Newton methods for unconstrained minimisation
[RAE-TR-77132] N78-31845
A method for the exact determination of noise parameters of active twoports in the frequency range 1 GHz to 11 GHz
[RAE-LIB-TRANS-1963] N78-31877
**ROYAL NETHERLANDS METEOROLOGICAL INST., DE BILT.**
Meteorological and oceanographic observations on board Netherlands lightvessels in the North Sea, 1971
[KNMI-141-23] N78-31678
**ROYAL SIGNALS AND RADAR ESTABLISHMENT, MALVERN [ENGLAND].**
The roles for CCD and SAW in signal processing
N78-31281

## S

**SANDIA LABS., ALBUQUERQUE, N. MEX.**
RF plasma enhanced vapor deposition and etching of silicon nitride
[SAND-77-2070] N78-31176
Activated gas reactions with silicone and epoxy resins
[SAND-77-1429C] N78-31201
Elevated temperature creep and fatigue damage of a 2.25 Cr-1 Mo steel weldment
[SAND-77-1556] N78-31229
Performance evaluation of wind energy conversion systems using the method of bins: Current status
[SAND-77-1375] N78-31580
REB focusing in a high-voltage diode
[SAND-78-6005] N78-31883
Detection of 511 keV positron annihilation radiation from the galactic center direction
N78-31978
**SANDIA LABS., LIVERMORE, CALIF.**
Hybrid trajectory simulation of a parachute system
[SAND-78-8668] N78-31054
Graphics for the hybrid stores separation simulation of the B77 system
[SAND-78-8212] N78-31099
Solar central receiver power plants
[SAND-77-8510] N78-31550
**SCHOOL OF AEROSPACE MEDICINE, BROOKS AFB, TEX.**
Mathematical analysis and computer simulation in military mission workload assessment
N78-31758
**SCIENCE APPLICATIONS, INC., BERKELEY, CALIF.**
A wire passing by a circular aperture in an infinite ground plane
[AD-A055583] N78-31340
**SCIENCE APPLICATIONS, INC., HUNTSVILLE, ALA.**
A computer version of the US Standard Atmosphere, 1978
[NASA-CR-150778] N78-31632
Analysis of vector wind change with respect to time for Vandenberg Air Force Base, California
[NASA-CR-150776] N78-31663
Analysis of wind bias change with respect to time at Cape Kennedy, Florida, and Vandenberg AFB, California
[NASA-CR-150777] N78-31664
Analysis of vector wind change with respect to time for Cape Kennedy, Florida
[NASA-CR-150779] N78-31665
**SCIENCE APPLICATIONS, INC., LA JOLLA, CALIF.**
Ion cloud modeling
[AD-A055969] N78-31648
**SEVILLE RESEARCH CORP., PENSACOLA, FLA.**
US Navy fleet aviation training program development
[AD-A055788] N78-31734
**SOCIETE ANONYME DE TELECOMMUNICATIONS, PARIS [FRANCE].**
Modelization of metal insulating semiconductor devices on CgHgTe application to a charge transfer device for infrared imagery
N78-31301
**SOLAR CONTROL CORP., BOULDER, COLO.**
Solar Control design package
[NASA-CR-150771] N78-31535
**SOLAR ENGINEERING AND MFG. CO., FT. LAUDERDALE, FLA.**
Design data brochure: Solar hot water system
[NASA-CR-150699] N78-31538
**SOUTH DAKOTA STATE UNIV., BROOKINGS.**
Application of heat-flow temperature model for remotely assessing near surface soil moisture by thermography
[PB-279616/7] N78-31518
**SOUTHAMPTON UNIV. [ENGLAND].**
A novel signal integrator using CCDs
N78-31316
**SOUTHEASTERN MASSACHUSETTS UNIV., NORTH DARTMOUTH.**
Some new results on image processing and recognition
[AD-A055862] N78-31807

**SOUTHERN RESEARCH INST., BIRMINGHAM, ALA.**
Development of a portable device to collect sulfuric acid aerosol
[PB-280048/0] N78-31603
**SOUTHWEST RESEARCH INST., SAN ANTONIO, TEX.**
A technique for evaluating fuel and hydraulic fluid ballistic vulnerability
[AD-A055058] N78-31188
Detailed analysis of the fundamental ultrasonic response data from stainless steel stress corrosion crack specimens
[EPRI-NP-676-SR] N78-31448
**SPERRY RESEARCH CENTER, SUDBURY, MASS.**
Signal Processing with a Reflective Dot Array [RDA]
N78-31285
**SRI INTERNATIONAL CORP., MENLO PARK, CALIF.**
EPRI-NASA cooperative project on stress corrosion cracking of Zircaloys
[NASA-CR-157577] N78-31230
**STANDARD TELECOMMUNICATION LABS. LTD., HARLOW [ENGLAND].**
A CCD delay line Doppler analyser
N78-31318
**STANFORD RESEARCH INST., MENLO PARK, CALIF.**
Two FORTRAN programs for calculating global ionospheric amplitude and phase scintillation
[AD-A055273] N78-31641
**STANFORD UNIV., CALIF.**
The transonic flow on a helicopter rotor
N78-31042
Large eddy simulation of incompressible turbulent channel flow
[NASA-CR-157575] N78-31383
Diagnostic improvements in medical ultrasonic imaging systems
N78-31710
A comparison of control modes for time delayed remote manipulation
N78-31737
Analysis and performance of computer instruction sets
N78-31780
Topics in computational geometry
N78-31783
Numerical algorithms for nonlinearly constrained optimization
N78-31790
Stochastic modelling of computer systems and networks
N78-31816
Regenerative simulation of response times in networks of Queues II multiple job types
[AD-A055584] N78-31831
Axial field limitations in MHD generators
N78-31905
Elastic properties of one-dimensional conductors and semiconductors
N78-31913
Incapsulation and annealing of ion implanted selenium in GaAs
N78-31919
Electron tunneling into the A15 superconductors: Nb3Sn, V3Si, and Nb3Ge
N78-31924
**STATE AGRICULTURAL UNIV., WAGENINGEN [NETHERLANDS].**
Discharge measurement structures
[PUBL-161] N78-31395
**STATE UNIV. OF NEW YORK, STONY BROOK.**
A real-time language or small processors: Design, definition, and implementation
N78-31784
**STATE UNIV. OF NEW YORK AT ALBANY.**
Resonant scattering of electromagnetic radiation from non-spherical optically anisotropic targets with axial symmetry
N78-31322
Statistical properties of particles confined by irregular surfaces
N78-31918
**STATE UNIV. OF NEW YORK AT BUFFALO.**
Quantum theory of cyclotron resonance lineshape for the inversion layer electrons in Metal-Oxide-Semiconductor [MOS]
N78-31925
**STATE UNIV. OF NEW YORK AT BUFFALO, AMHERST.**
Radar image modeling and processing for real-time RF simulation
[AD-A055060] N78-31333
Teper technical evaluation program evaluation and restructuring
[AD-A055757] N78-31343
**SULZER BROS. LTD., WINTERTHUR [SWITZERLAND].**
High temperature corrosion mechanics
N78-31231
**SYBUCON, INC., ATLANTA, GA.**
Verification of a three-dimensional turbulent boundary-layer calculation method
[AD-A055606] N78-31388
**SYRACUSE UNIV., N. Y.**
Method of moment thin wire computer program comparisons for complex structures and coarse accuracy
[AD-A055759] N78-31341
Sedimentary geochemistry of carbonate-silicate cyclic sedimentation in deep sea
N78-31477
Integral formulation of Einstein's equations and Mach's principle
N78-31866
Elastophotoconductance in polycrystalline films of cadmium-sulfide
N78-31921
Anomalous hall effect and oscillatory photoconductivity in p-type mercury cadmium telluride
N78-31926
Large scale information systems, volume 1
[AD-A054942] N78-31950
**SYSTEM DEVELOPMENT CORP., SANTA MONICA, CALIF.**
Software acquisition management guidebook: Cost estimation and measurement
[AD-A055574] N78-31809
**SYSTEMS RESEARCH LAB., CHAMPAIGN, ILL.**
Digital controller design: Analysis of the annular suspension pointing system
[NASA-CR-150807] N78-31825

## T

**TADIRAN ISRAEL ELECTRONICS INDUSTRIES, LTD., TEL AVIV.**
TADIRAN high energy lithium batteries
[LBR-1501] N78-31544
**TECHNISCHE HOCHSCHULE, DARMSTADT [WEST GERMANY].**
Determination of stress and strain of air traffic control officers
N78-31751
**TECHNISCHE UNIV., BERLIN [WEST GERMANY].**
Investigation on the influence of a hydrodynamic precursor stage on the heat transfer at a flat channel wall
[ILR-22] N78-31397
**TECHNISCHE UNIVERSITAET, MUNICH [WEST GERMANY].**
Physiological measures of workloads: Correlations between physiological parameters and operational performance
N78-31753
**TECHNOCHEMIE G.M.B.H., HEIDELBERG [WEST GERMANY].**
Evaluation of built-in stresses during manufacture of elements made of carbon fiber reinforced plastics
[ESA-CR[P]-1058] N78-31179
**TECHNOLOGY, INC., SAN ANTONIO, TEX.**
An experimental investigation of the effect of 1.06 micrometers laser light on the transparent ocular media
[AD-A055650] N78-31719
**TECHNOLOGY SERVICE CORP., SANTA MONICA, CALIF.**
Multidomain algorithm evaluation, volume 1
[AD-A054357] N78-31826
Multidomain algorithm evaluation, volume 2
[AD-A054358] N78-31827
**TELECOM, INC., VIENNA, VA.**
Baseline National Airspace Data Interchange Network [NADIN] data base
[AD-A056112] N78-31949
**TELEDYNE CONTINENTAL MOTORS, MUSKEGON, MICH.**
Automotive diesel technology program
[SAN-1099-1] N78-31436
**TELEDYNE/MCCORMICK SELPH, HOLLISTER, CALIF.**
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 1
[NASA-CR-150791] N78-31159
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 1, section 2
[NASA-CR-150792] N78-31160
Qualification test for safety and arming device MSFC PN 10A00465 TMc/S PN 816780 for space shuttle solid rocket booster, volume 2
[NASA-CR-150793] N78-31161
**TEMPLE UNIV., PHILADELPHIA, PA.**
Studies in fluorescence spectroscopy
N78-31182
Kolmogorov-Smirnov test statistics for the gamma distribution with unknown parameters
N78-31850
**TENNESSEE UNIV., KNOXVILLE.**
Dynamics of the recovery of damaged tundra vegetation
[ORO-4180-7] N78-31514
Estimation of the operating characteristics of the two-parameter beta method
[AD-A055611] N78-31860
**TENNESSEE VALLEY AUTHORITY, CHATTANOOGA.**
Least-squares resolution of gamma-ray spectra in environmental samples
[PB-280237/9] N78-31886
**TEXAS A&M UNIV., COLLEGE STATION.**
Deep Ocean Mining Environmental Study, DOMES. Unpublished manuscript no. 12: Lagrangian diffusion parameters in the surface water of the tropical North Pacific Ocean
[PB-281388/9] N78-31683
**TEXAS INSTRUMENTS, INC., DALLAS.**
State-of-the-art of CCD and SAW technologies
N78-31280
Spectral analysis using the CCD Chirp Z-transform
N78-31313
IC fabrication using electron-beam technology
[AD-A055610] N78-31368
The design and demonstration of an advanced data collection/position locating system, addendum
[NASA-CR-156813] N78-31819
**TEXAS TECHNOLOGICAL UNIV., LUBBOCK.**
Frequency domain stability in single and multi-dimensional systems
[AD-A055393] N78-31841
Basic optimal estimation and control problems in Hilbert space
[AD-A055614] N78-31864
Resolution space, networks, and non-self-adjoint spectral theory II
[AD-A055613] N78-31865
**TEXAS UNIV., AUSTIN.**
Light on light: Satyendra Nath Bose's work on radiative equilibrium
[ORO-3992-307] N78-31942
**TEXAS UNIV. AT ARLINGTON.**
An evaluation of the fluidic oxygen partial pressure sensor
[AD-A055362] N78-31743
**TEXAS UNIV. AT AUSTIN.**
A dual optimization framework for some problems of information theory and statistics
[AD-A055155] N78-31802
A new class of feasible direction methods
[AD-A055032] N78-31803
Degeneracy in special purpose primal algorithms used in obtaining least absolute value estimators
[AD-A055042] N78-31838
The simplex SON algorithm for LP/embedded network problems
[AD-A055156] N78-31863
Experimental investigation of outdoor propagation of finite-amplitude noise
[NASA-CR-2992] N78-31876
**TEXAS UNIV. AT DALLAS, RICHARDSON.**
Geothermal exploration techniques: A case study
[EPRI-ER-680] N78-31577
**THOMSON-CSF, BAGNEUX [FRANCE].**
CCD delay lines for the processing of a radar signal: Application to an MTI
N78-31317
**THOMSON-CSF, MALAKOFF [FRANCE].**
Applications of piezoelectric convoluters to radar signal processing
N78-31314
**TORONTO UNIV. [ONTARIO].**
Single and dual air curtain jets used as protection against precipitation
[UTIAS-227] N78-31269
The analysis of ambient air using atmospheric pressure chemical ionization mass spectrometry
[UTIAS-219] N78-31591
Numerical minimization methods for functionals: Comparison and extensions
[UTIAS-209] N78-31835
The influence of background noise level and signal duration on the judged annoyance of aircraft noise
[UTIAS-228] N78-31875
**TRW DEFENSE AND SPACE SYSTEMS GROUP, REDONDO BEACH, CALIF.**
LSI video compression and computational modules utilizing digital charge coupled devices
N78-31298
Multi-KW dc distribution system technology research study
[NASA-CR-150789] N78-31353
**TRW, INC., LAWNDALE, CALIF.**
Monolithic 20W 2GHz transistor and monolithic 5W 4GHz transistor
[AD-A055249] N78-31360

## U

**ULTRASYSTEMS, INC., IRVINE, CALIF.**
Synthesis of perfluoroalkylene aromatic diamines
[NASA-CR-159403] N78-31235
**UNITED TECHNOLOGIES CORP., WINDSOR LOCKS, CONN.**
Preliminary design of an accident Information Retrieval System [AIRS]
[AD-A055590] N78-31952

**UTAH STATE UNIV., LOGAN.**
Use and abuse of the regulatory process in a developing solar energy space conditioning industry
[PB-280165/2] N78-31588
**UTAH UNIV., SALT LAKE CITY.**
Application of direct contact heat exchangers to geothermal power production cycles
[IDO-1549-8] N78-31578

## V

**VANDERBILT UNIV., NASHVILLE, TENN.**
Spectroscopic studies of ultraviolet lasing transitions in diatomic molecules
[ORO-5005-16] N78-31423
**VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.**
Simulation of the urban neutral boundary layer for the model study of wind loads on tall buildings
[PB-280787/3] N78-31278
Functional analytic treatment of linear transport equations in kinetic theory and neutron transport theory
N78-31888
**VIRGINIA UNIV., CHARLOTTESVILLE.**
Magnetic interactions in the hubbard model
N78-31922
Gas response to perturbations in disk galaxies
N78-32026
**VOUGHT CORP., HAMPTON, VA.**
Modeling of a latent fault detector in a digital system
[NASA-CR-145371] N78-31794

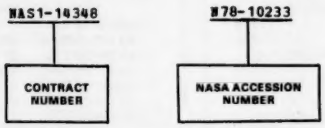
## W

**WASHINGTON STATE UNIV., PULLMAN.**
Optimization and testing of highway materials to mitigate ice adhesion
[PB-280927/5] N78-31276
**WASHINGTON UNIV., SEATTLE.**
The interrelationships of density and fiber orientation on the mechanical properties of fiberboard
N78-31172
A study of the geochemistry of pelagic sediments: The interaction of trace metals and magnetic minerals with sedimentary environments
N78-31631
Programming by abstracts demonstration
N78-31788
Combinatorial optimization: What is the state of the art
[AD-A055722] N78-31842
Small sample robustness properties of generalized M-estimators applied to first order autoregression
N78-31853
Cross sections relevant to gamma ray astronomy
N78-32006
**WATERLOO UNIV. [ONTARIO].**
Continuation study of the potential for solar heating of buildings in Canada
[NP-23162] N78-31583
**WAYNE STATE UNIV., DETROIT, MICH.**
Radiolysis studies on reactive intermediates
[COO-2086-88] N78-31200
**WEAPONS RESEARCH ESTABLISHMENT, SALISBURY [AUSTRALIA].**
Upper atmosphere wind and temperature profiles over Woomera at twilight
[WRE-TR-1921[W]] N78-31668
**WESTINGHOUSE DEFENSE AND ELECTRONIC SYSTEMS CENTER, BALTIMORE, MD.**
Capture effect array glide slope guidance study
[AD-A055678] N78-31073
**WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.**
Cryogenic recovery analysis of forced flow supercritical helium cooled superconductors
[WFPS-TME-039] N78-31273
**WESTINGHOUSE ELECTRIC CORP., TAMPA, FLA.**
Design and cost study of a nickel-iron oxide battery for electric vehicles. Volume 2: Public report
[ANL-K-3723-1] N78-31551
**WHITTAKER CORP., SAN DIEGO, CALIF.**
Polymeric foams from cross-linkable poly-n-ary benebenzimidazoles
[NASA-CASE-ARC-11008-1] N78-31232
**WIGGINS [J. H.] CO., REDONDO BEACH, CALIF.**
Model verification of large structural systems
[NASA-CR-150811] N78-31464
**WISCONSIN UNIV. - MADISON.**
Time series determination of transfer functions in random fatigue
[AD-A055656] N78-31471
**WORLD METEOROLOGICAL ORGANIZATION, GENEVA [SWITZERLAND].**
World Weather Watch. The role of satellites in WMO programmes in the 1980s
[WMO-494] N78-31676
Present techniques of tropical storm surge prediction
[WMO-500] N78-31677

## Y

**YALE UNIV., NEW HAVEN, CONN.**
Experimental studies of electron impact depopulation of excited states of atoms: Application to laser development for fusion and isotope separation
[COO-4199-1] N78-31884

## Typical Contract Number Index Listing




Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.


AF PROJ. 682J
N78-31545
AF PROJ. 723 N78-31593
AF PROJ. 1366
N78-31386
AF PROJ. 2128
N78-31642
N78-32020
AF PROJ. 2303
N78-31187
N78-31881
AF PROJ. 2304
N78-31855
N78-31864
N78-31865
AF PROJ. 2306
N78-31928
N78-31930
AF PROJ. 2307
N78-31048
AF PROJ. 2308
N78-31594
AF PROJ. 2567
N78-31051
AF PROJ. 3066
N78-31111
AF PROJ. 4506
N78-31826
N78-31827
AF PROJ. 4519
N78-31334
AF PROJ. 7071
N78-31149
AF PROJ. 7071-00-12
N78-31329
AF PROJ. 7351
N78-31218
AF-AFOSR-2631-74
N78-31841
N78-31864
N78-31865
AF-AFOSR-2694-74
N78-31420
AF-AFOSR-2710-74
N78-31594
AF-AFOSR-2796-76
N78-31857
AF-AFOSR-2916-76
N78-31118
AF-AFOSR-2951-76
N78-31807
AF-AFOSR-2968-76
N78-31124
AF-AFOSR-3046-76
N78-31839
AF-AFOSR-3083-76
N78-31768
AF-AFOSR-3109-76
N78-31855
AF-AFOSR-3280-77
N78-31191
AF-AFOSR-3281-77
N78-31859
AF-AFOSR-3322-77
N78-31446
AF-AFOSR-3360-77
N78-31858
AF-AFOSR-3361-77
N78-31365
AF-AFOSR-3364-77
N78-31649
ARPA ORDER 2777
N78-31641
ARPA ORDER 2935
N78-31338
ARPA ORDER 3211
N78-31927
ARPA ORDER 3414
N78-31810
AT(49-24)-0211
N78-31447
AT(49-25)-1004
N78-31657
CHR-CT-75.01135.07
N78-31437
CPSC-C-76-0067
N78-31727
N78-31728
DA PROJ. 1F2-62209-AH-76
N78-31952
DA PROJ. 1G2-62207-AH-89
N78-31089
DA PROJ. 1L1-61102-AH-45
N78-31044
N78-31792
DA PROJ. 1L1-61102-B-53A
N78-31671
DA PROJ. 1L1-62705-AH-94
N78-31363
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HC-08899-11 N78-31714
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NAONR-18-69 N78-31219
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NAS1-13507 N78-31291
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NAS1-14614 N78-31085
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NAS3-20392 N78-31141
N78-31142
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NAS3-20627 N78-31108
NAS3-21021 N78-31380
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NR PROJ. 047-172
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NR PROJ. 064-436
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NSF APR-75-18004
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NSF C-76-19848 N78-31944
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NSF ENV-77-06013 N78-31970
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NSF MCS-77-04441 N78-31812
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NSF 78-01684 N78-32006
NSG-1050 N78-31872
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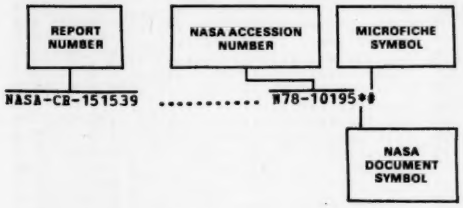
OSURF PROJ. 711055 N78-32027
PHS-NIOSH-210-76-0110 N78-31613
PROJ. E-21-657 N78-31412
PROJ. 034-241-012 N78-31074
PROJ. 3246 N78-31573
RR0110301 N78-31880
RR0140941 N78-31336
RR0420401 N78-31860
SF11112160 N78-31931
SF32399491 N78-31336
SF43452702 N78-31468
W-31-109-ENG-38 N78-31195 N78-31548 N78-31955
W-7405-ENG-26 N78-31170 N78-31178 N78-31197 N78-31224 N78-31228 N78-31273 N78-31473 N78-31515 N78-31674 N78-31722
W-7405-ENG-36 N78-31265 N78-31267 N78-31410 N78-31553 N78-31581 N78-31724 N78-31936
W-7405-ENG-38 N78-31551
W-7405-ENG-48 N78-31177 N78-31199 N78-31225 N78-31226 N78-31227 N78-31266 N78-31371 N78-31421 N78-31422 N78-31474 N78-31475 N78-31549 N78-31652 N78-31721 N78-31843 N78-31882 N78-31885 N78-31937 N78-31938 N78-32002
W-7405-ENG-82 N78-31193 N78-31196
WP323000 N78-31152
WP55525000 N78-31741
XP11101100 N78-31331
ZP53532001 N78-31765
ZP57571001 N78-31547
383-21-03-02 N78-32029
505-02-13-46 N78-31354
505-04 N78-31109
505-07-23-07 N78-31404
505-09-42 N78-31739
505-10-13-02 N78-31101
505-10-23-03 N78-31792
505-11-33-01 N78-31045
505-15-33-02 N78-31836
506-16 N78-31213
506-18-26 N78-31413
506-21 N78-31384
516-53-03-21 N78-31043
652-01-82-00-72 N78-31509
716-01-02 N78-31108
743-01-03-05 N78-31793

## Typical Report/Accession Number Index Listing

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A-7390 ..... N78-31739*#
A-7608 ..... N78-32029*#

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AAI-2383/2384-800-TR-2 ..... N78-31727 #

ACUREX/TR-77/87 ..... N78-31612 #

AD-A049305 ..... N78-31075 #
AD-A053827 ..... N78-31414 #
AD-A054022 ..... N78-31110 #
AD-A054226 ..... N78-31545 #
AD-A054234 ..... N78-31880 #
AD-A054235 ..... N78-31796 #
AD-A054237 ..... N78-31386 #
AD-A054239 ..... N78-31592 #
AD-A054243 ..... N78-31046 #
AD-A054247 ..... N78-31764 #
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AD-A054253 ..... N78-31215 #
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AD-A054759 ..... N78-31387 #
AD-A054762 ..... N78-31800 #
AD-A054769 ..... N78-31468 #
AD-A054784 ..... N78-31640 #
AD-A054802 ..... N78-31900 #
AD-A054804 ..... N78-31063 #
AD-A054826 ..... N78-31799 #
AD-A054832 ..... N78-31112 #
AD-A054833 ..... N78-31856 #
AD-A054834 ..... N78-31100 #
AD-A054842 ..... N78-31187 #
AD-A054844 ..... N78-31594 #
AD-A054846 ..... N78-31332 #
AD-A054878 ..... N78-31144 #
AD-A054879 ..... N78-31145 #
AD-A054880 ..... N78-31146 #
AD-A054881 ..... N78-31147 #
AD-A054925 ..... N78-31692 #
AD-A054942 ..... N78-31950 #
AD-A054971 ..... N78-31361 #
AD-A054978 ..... N78-31855 #
AD-A054980 ..... N78-31930 #
AD-A054991 ..... N78-31716 #

AD-A055006 ..... N78-31469 #
AD-A055012 ..... N78-31169 #
AD-A055013 ..... N78-31407 #
AD-A055019 ..... N78-31338 #
AD-A055022 ..... N78-31839 #
AD-A055024 ..... N78-31261 #
AD-A055025 ..... N78-31931 #
AD-A055026 ..... N78-31064 #
AD-A055027 ..... N78-31191 #
AD-A055028 ..... N78-31671 #
AD-A055029 ..... N78-31051 #
AD-A055032 ..... N78-31803 #
AD-A055038 ..... N78-31742 #
AD-A055039 ..... N78-31091 #
AD-A055040 ..... N78-31092 #
AD-A055042 ..... N78-31838 #
AD-A055045 ..... N78-31951 #
AD-A055046 ..... N78-31801 #
AD-A055048 ..... N78-31337 #
AD-A055058 ..... N78-31188 #
AD-A055060 ..... N78-31333 #
AD-A055066 ..... N78-31878 #
AD-A055072 ..... N78-31881 #
AD-A055073 ..... N78-31241 #
AD-A055076 ..... N78-31186 #
AD-A055077 ..... N78-31467 #
AD-A055078 ..... N78-31270 #
AD-A055079 ..... N78-31593 #
AD-A055080 ..... N78-31766 #
AD-A055082 ..... N78-31415 #
AD-A055083 ..... N78-31356 #
AD-A055084 ..... N78-31357 #
AD-A055085 ..... N78-31358 #
AD-A055086 ..... N78-31928 #
AD-A055088 ..... N78-31715 #
AD-A055097 ..... N78-31765 #
AD-A055099 ..... N78-31899 #
AD-A055101 ..... N78-31168 #
AD-A055102 ..... N78-31940 #
AD-A055104 ..... N78-31089 #
AD-A055105 ..... N78-31239 #
AD-A055108 ..... N78-31113 #
AD-A055109 ..... N78-31050 #
AD-A055111 ..... N78-31446 #
AD-A055113 ..... N78-31257 #
AD-A055115 ..... N78-31148 #
AD-A055116 ..... N78-31119 #
AD-A055118 ..... N78-31830 #
AD-A055123 ..... N78-31326 #
AD-A055125 ..... N78-31336 #
AD-A055126 ..... N78-31240 #
AD-A055140 ..... N78-31047 #
AD-A055152 ..... N78-31769 #
AD-A055155 ..... N78-31802 #
AD-A055156 ..... N78-31863 #
AD-A055157 ..... N78-31682 #
AD-A055159 ..... N78-31470 #
AD-A055170 ..... N78-31328 #
AD-A055174 ..... N78-31768 #
AD-A055175 ..... N78-31120 #
AD-A055176 ..... N78-31359 #
AD-A055177 ..... N78-31828 #
AD-A055178 ..... N78-31797 #
AD-A055179 ..... N78-31090 #
AD-A055180 ..... N78-31416 #
AD-A055182 ..... N78-31546 #
AD-A055187 ..... N78-31932 #
AD-A055188 ..... N78-31149 #
AD-A055189 ..... N78-31156 #
AD-A055190 ..... N78-31829 #
AD-A055191 ..... N78-31077 #
AD-A055192 ..... N78-31150 #
AD-A055194 ..... N78-31327 #
AD-A055195 ..... N78-31929 #
AD-A055196 ..... N78-31121 #
AD-A055197 ..... N78-31335 #
AD-A055198 ..... N78-31933 #
AD-A055199 ..... N78-31364 #
AD-A055200 ..... N78-31767 #
AD-A055209 ..... N78-31945 #

AD-A055224 ..... N78-31771 #
AD-A055226 ..... N78-31133 #
AD-A055229 ..... N78-31419 #
AD-A055234 ..... N78-31122 #
AD-A055235 ..... N78-31798 #
AD-A055236 ..... N78-31329 #
AD-A055237 ..... N78-31330 #
AD-A055238 ..... N78-31717 #
AD-A055239 ..... N78-31078 #
AD-A055240 ..... N78-31217 #
AD-A055244 ..... N78-31637 #
AD-A055245 ..... N78-31638 #
AD-A055246 ..... N78-31639 #
AD-A055249 ..... N78-31360 #
AD-A055251 ..... N78-31242 #
AD-A055253 ..... N78-31363 #
AD-A055254 ..... N78-31820 #
AD-A055255 ..... N78-31417 #
AD-A055256 ..... N78-31418 #
AD-A055257 ..... N78-31173 #
AD-A055258 ..... N78-31331 #
AD-A055260 ..... N78-31271 #
AD-A055262 ..... N78-31111 #
AD-A055264 ..... N78-31642 #
AD-A055266 ..... N78-32020 #
AD-A055268 ..... N78-31190 #
AD-A055269 ..... N78-31334 #
AD-A055273 ..... N78-31641 #
AD-A055277 ..... N78-31770 #
AD-A055279 ..... N78-31837 #
AD-A055281 ..... N78-31218 #
AD-A055283 ..... N78-31362 #
AD-A055286 ..... N78-31048 #
AD-A055317 ..... N78-31071 #
AD-A055318 ..... N78-31431 #
AD-A055323 ..... N78-31065 #
AD-A055324 ..... N78-31366 #
AD-A055325 ..... N78-31941 #
AD-A055343 ..... N78-31095 #
AD-A055359 ..... N78-31220 #
AD-A055362 ..... N78-31743 #
AD-A055366 ..... N78-31219 #
AD-A055383 ..... N78-31804 #
AD-A055384 ..... N78-31389 #
AD-A055388 ..... N78-31391 #
AD-A055393 ..... N78-31841 #
AD-A055430 ..... N78-31392 #
AD-A055447 ..... N78-31070 #
AD-A055449 ..... N78-31369 #
AD-A055450 ..... N78-31345 #
AD-A055451 ..... N78-31720 #
AD-A055482 ..... N78-31130 #
AD-A055529 ..... N78-31074 #
AD-A055531 ..... N78-31718 #
AD-A055574 ..... N78-31809 #
AD-A055576 ..... N78-31221 #
AD-A055583 ..... N78-31340 #
AD-A055584 ..... N78-31831 #
AD-A055590 ..... N78-31952 #
AD-A055591 ..... N78-31102 #
AD-A055605 ..... N78-31324 #
AD-A055606 ..... N78-31388 #
AD-A055610 ..... N78-31368 #
AD-A055611 ..... N78-31860 #
AD-A055612 ..... N78-31840 #
AD-A055613 ..... N78-31865 #
AD-A055614 ..... N78-31864 #
AD-A055649 ..... N78-31124 #
AD-A055650 ..... N78-31719 #
AD-A055656 ..... N78-31471 #
AD-A055658 ..... N78-31116 #
AD-A055659 ..... N78-31420 #
AD-A055662 ..... N78-31432 #
AD-A055667 ..... N78-31370 #
AD-A055670 ..... N78-31649 #
AD-A055671 ..... N78-31810 #
AD-A055672 ..... N78-31098 #
AD-A055678 ..... N78-31073 #
AD-A055718 ..... N78-31152 #
AD-A055719 ..... N78-31433 #
AD-A055721 ..... N78-31434 #
AD-A055722 ..... N78-31842 #
AD-A055724 ..... N78-31447 #
AD-A055753 ..... N78-31175 #
AD-A055754 ..... N78-31118 #
AD-A055756 ..... N78-31367 #
AD-A055757 ..... N78-31343 #
AD-A055758 ..... N78-31342 #
AD-A055759 ..... N78-31341 #

AD-A055760 ..... N78-31344 #
AD-A055762 ..... N78-31513 #
AD-A055765 ..... N78-31115 #
AD-A055766 ..... N78-31114 #
AD-A055773 ..... N78-31646 #
AD-A055774 ..... N78-32033 #
AD-A055777 ..... N78-31806 #
AD-A055780 ..... N78-31647 #
AD-A055784 ..... N78-31094 #
AD-A055788 ..... N78-31734 #
AD-A055789 ..... N78-31097 #
AD-A055824 ..... N78-31096 #
AD-A055827 ..... N78-31365 #
AD-A055828 ..... N78-31859 #
AD-A055842 ..... N78-31858 #
AD-A055844 ..... N78-31857 #
AD-A055846 ..... N78-31053 #
AD-A055849 ..... N78-31134 #
AD-A055857 ..... N78-31672 #
AD-A055861 ..... N78-31673 #
AD-A055862 ..... N78-31807 #
AD-A055863 ..... N78-31808 #
AD-A055887 ..... N78-31093 #
AD-A055891 ..... N78-31174 #
AD-A055892 ..... N78-31123 #
AD-A055898 ..... N78-31088 #
AD-A055899 ..... N78-31052 #
AD-A055905 ..... N78-31246 #
AD-A055918 ..... N78-31547 #
AD-A055920 ..... N78-31072 #
AD-A055925 ..... N78-31934 #
AD-A055937 ..... N78-31408 #
AD-A055942 ..... N78-31339 #
AD-A055943 ..... N78-31643 #
AD-A055969 ..... N78-31648 #
AD-A055971 ..... N78-31645 #
AD-A055973 ..... N78-31805 #
AD-A055976 ..... N78-31264 #
AD-A055979 ..... N78-31245 #
AD-A055980 ..... N78-31192 #
AD-A055981 ..... N78-31263 #
AD-A055983 ..... N78-31644 #
AD-A055985 ..... N78-31390 #
AD-A055988 ..... N78-31244 #
AD-A055989 ..... N78-31262 #
AD-A055992 ..... N78-31151 #
AD-A056052 ..... N78-31131 #
AD-A056098 ..... N78-31062 #
AD-A056112 ..... N78-31949 #
AD-A056113 ..... N78-31256 #
AD-A056148 ..... N78-31325 #
AD-A056151 ..... N78-31669 #
AD-A056200 ..... N78-31132 #

AD-E100057 ..... N78-31144 #
AD-E100058 ..... N78-31146 #
AD-E100059 ..... N78-31145 #
AD-E100060 ..... N78-31147 #
AD-E300216 ..... N78-31648 #
AD-E300226 ..... N78-31643 #
AD-E400039 ..... N78-31258 #
AD-E400065 ..... N78-31260 #
AD-E400087 ..... N78-31259 #
AD-E400108 ..... N78-31264 #
AD-E400115 ..... N78-31245 #
AD-E400124 ..... N78-31192 #
AD-E400125 ..... N78-31263 #
AD-E400159 ..... N78-31151 #
AD-E430024 ..... N78-31800 #
AD-E430025 ..... N78-31189 #
AD-E430032 ..... N78-31049 #

AEDC-TR-78-4 ..... N78-31051 #

AFAL-TR-77-118-VOL-1 ..... N78-31102 #
AFAL-TR-77-249 ..... N78-31366 #

AFAPL-TR-76-81-VOL-1 ..... N78-31111 #
AFAPL-TR-77-71 ..... N78-31545 #
AFAPL-TR-77-79 ..... N78-31064 #
AFAPL-TR-77-92 ..... N78-31116 #
AFAPL-TR-78-14-PT-1 ..... N78-31240 #

AFATL-TR-78-4 ..... N78-31051 #

AFFDL-TR-77-58 ..... N78-31097 #
AFFDL-TR-77-79-VOL-2 ..... N78-31430 #
AFFDL-TR-77-112 ..... N78-31120 #
AFFDL-TR-77-113 ..... N78-31386 #

AFFDL-TR-77-122-VOL-1 ..... N78-31052 #
AFFDL-TR-77-122-VOL-2-APP-A ..... N78-31050 #
AFFDL-TR-78-15 ..... N78-31388 #

AFGL-AFSG-384 ..... N78-31640 #

AFGL-TR-78-0058 ..... N78-31640 #

AFIT/EE/GGC/77-2 ..... N78-31078 #
AFIT/GA/EE/77-3 ..... N78-31122 #
AFIT/GCS/EE/77-4 ..... N78-31820 #
AFIT/GCS/EE/77-6 ..... N78-31806 #
AFIT/GCS/EE/77-11 ..... N78-31797 #
AFIT/GCS/EE/78-1 ..... N78-31798 #
AFIT/GCS/EE/78-3 ..... N78-31148 #
AFIT/GCS/EE/78-6 ..... N78-31133 #
AFIT/GCS/MA/78-1 ..... N78-31945 #
AFIT/GE/EE/77-9 ..... N78-31329 #
AFIT/GE/EE/77-10 ..... N78-31369 #
AFIT/GE/EE/77-13-VOL-1 ..... N78-31090 #
AFIT/GE/EE/77-26 ..... N78-31345 #
AFIT/GE/EE/77-32 ..... N78-31330 #
AFIT/GE/EE/77-33 ..... N78-31327 #
AFIT/GE/EE/77-38 ..... N78-31929 #
AFIT/GE/EE/77-39 ..... N78-31121 #
AFIT/GE/EE/77-41 ..... N78-31335 #
AFIT/GE/EE/77D-34 ..... N78-31717 #
AFIT/GE/EE/77S-6 ..... N78-31150 #
AFIT/GE/EE/78-2 ..... N78-31720 #
AFIT/GE/EE/78-3 ..... N78-31326 #
AFIT/GE/EE/78-4 ..... N78-31933 #
AFIT/GE/EE/78-5 ..... N78-31364 #
AFIT/GE/EE/78-7 ..... N78-31767 #
AFIT/GE/EE/78-11 ..... N78-31771 #
AFIT/GEP/PH/76-8 ..... N78-31416 #
AFIT/GEP/PH/77-5 ..... N78-31418 #
AFIT/GEP/PH/77-11 ..... N78-31417 #
AFIT/GGC/EE-77-6 ..... N78-31156 #
AFIT/GGC/EE/77-3 ..... N78-31149 #
AFIT/GGC/EE/78-1 ..... N78-31829 #
AFIT/GGC/EE/78-4 ..... N78-31077 #
AFIT/GNE/PH/78M-3 ..... N78-31932 #
AFIT/GNE/PH/78M-8 ..... N78-31241 #
AFIT/GNE/PH/78M-9 ..... N78-31419 #

AFLRL-89 ..... N78-31188 #

AFML-TR-77-175 ..... N78-31218 #
AFML-TR-77-227 ..... N78-31243 #

AFOSR-78-0901TR ..... N78-31191 #
AFOSR-78-0902TR ..... N78-31389 #
AFOSR-78-0903TR ..... N78-31048 #
AFOSR-78-0911TR ..... N78-31839 #
AFOSR-78-0919TR ..... N78-31768 #
AFOSR-78-0937TR ..... N78-31930 #
AFOSR-78-0939TR ..... N78-31855 #
AFOSR-78-0947TR ..... N78-31446 #
AFOSR-78-0961TR ..... N78-31594 #
AFOSR-78-0966TR ..... N78-31187 #
AFOSR-78-0980TR ..... N78-31928 #
AFOSR-78-1028TR ..... N78-31118 #
AFOSR-78-1045TR ..... N78-31865 #
AFOSR-78-1046TR ..... N78-31864 #
AFOSR-78-1047TR ..... N78-31841 #
AFOSR-78-1054TR ..... N78-31124 #
AFOSR-78-1056TR ..... N78-31649 #
AFOSR-78-1061TR ..... N78-31420 #
AFOSR-78-1066TR ..... N78-31175 #
AFOSR-78-1093TR ..... N78-31808 #
AFOSR-78-1094TR ..... N78-31365 #
AFOSR-78-1102TR ..... N78-31859 #
AFOSR-78-1106TR ..... N78-31807 #
AFOSR-78-1111TR ..... N78-31857 #
AFOSR-78-1113TR ..... N78-31858 #

AFWL-TR-77-52 ..... N78-31340 #

AGARD-AG-232 ..... N78-31661 #
AGARD-AG-236 ..... N78-31401 #

AGARD-CP-216 ..... N78-31745 #
AGARD-CP-230 ..... N78-31279 #

AGARD-R-668 ..... N78-31126 #

AI-M-415 ..... N78-31951 #
AI-M-446 ..... N78-31899 #
AI-M-468 ..... N78-31801 #
AI-M-478 ..... N78-31840 #

AI-TR-419 ..... N78-31799 #

AMMRC-TR-77-20 ..... N78-31221 #
AMMRC-TR-78-16 ..... N78-31173 #

ANRL-TR-73-110-VOL-5 ..... N78-31593 #

ANS-1325 ..... N78-31123 #

ANL-K-77-3624-1 ..... N78-31548 #
ANL-K-3723-1 ..... N78-31551 #

ANL-SPG-2 ..... N78-31955 #

ANL-TRANS-1123 ..... N78-31198 #

APR-3 ..... N78-31202 #

AR-4 ..... N78-31970 #
AR-14 ..... N78-31540*#
AR-000-734 ..... N78-31104
AR-000-850 ..... N78-31457
AR-000-976 ..... N78-31668 #
AR-000-1111 ..... N78-31458

ARBRL-MR-02818 ..... N78-31800 #
ARBRL-MR-02820 ..... N78-31189 #
ARBRL-MR-02825 ..... N78-31049 #

ARC-CP-1386 ..... N78-31055 #
ARC-CP-1388 ..... N78-31058 #

ARC-36124 ..... N78-31055 #
ARC-37358 ..... N78-31058 #

ARH-LD-160 ..... N78-31203 #

ARI-RR-121 ..... N78-31187 #

ARL-MECH-ENG-REPT-149 ..... N78-31104

ARL-STRUC-NOTE-444 ..... N78-31458

ARL-STRUC-REPT-365 ..... N78-31457

ARL-TR-78-31 ..... N78-31876*#

ARLCD-MR-77006 ..... N78-31245 #

ARLCD-TR-77053 ..... N78-31258 #
ARLCD-TR-77080 ..... N78-31151 #
ARLCD-TR-78003 ..... N78-31260 #
ARLCD-TR-78006 ..... N78-31259 #

ARO-12290.9-E ..... N78-31408 #
ARO-13013.16-P ..... N78-31186 #
ARO-14653.5-R-EL ..... N78-31333 #
ARO-14673.1-R-E ..... N78-31262 #

ASD-TR-76-30 ..... N78-31095 #

ASPER/INH/T-77/0053/A ..... N78-31861 #

ASRL-TR-186-2 ..... N78-31097 #

ATC-85 ..... N78-31074 #

AVRADCOM-TR-78-20 ..... N78-31109*#
AVRADCOM-TR-78-34 ..... N78-31044*#

BBN-3761 ..... N78-31810 #
BBN-3794 ..... N78-31338 #
BBN-3807 ..... N78-31337 #

BDX-613-1709-REV ..... N78-31272 #
BDX-613-1725-REV ..... N78-31250 #
BDX-613-1790-REV ..... N78-31247 #
BDX-613-1836-REV ..... N78-31249 #
BDX-613-1905-REV ..... N78-31248 #

BM-RI-8275 ..... N78-31659 #

BNL-NUREG-23776 ..... N78-31222 #

BNL-50761 ..... N78-31725 #
BNL-50762 ..... N78-31595 #

BRL-IMR-284 ..... N78-31189 #
BRL-IMR-541 ..... N78-31049 #

BR60413 ..... N78-31845 #
BR61583 ..... N78-31055 #
BR61832 ..... N78-31059 #
BR63701 ..... N78-31877 #
BR64081 ..... N78-31738 #
BR64082 ..... N78-31207 #
BR64083 ..... N78-31087 #

CAA-D-78-5 ..... N78-31856 #

CALSPAN-ME-5955-A-1 ..... N78-31359 #

CASD-NAS-78-010 ..... N78-31380*#

CCS-310 ..... N78-31802 #
CCS-311 ..... N78-31803 #
CCS-316 ..... N78-31838 #
CCS-317 ..... N78-31863 #

CED-78-76 ..... N78-31969 #

CEL-CR-78.011 ..... N78-31547 #

CEPHAG-35/77 ..... N78-31347 #
CEPHAG-39/77 ..... N78-31909 #
CEPHAG-46/77 ..... N78-31844 #
CEPHAG-52/77 ..... N78-31832 #

CERL-IR-M-44 ..... N78-31878 #

CM-ISSN-0082-5255 ..... N78-31269 #
CM-ISSN-0082-5255 ..... N78-31591 #
CM-ISSN-0082-5255 ..... N78-31835 #
CM-ISSN-0082-5255 ..... N78-31875 #

COM-73-11713 ..... N78-31424 #
COM-73-11718 ..... N78-31693 #
COM-74-10971 ..... N78-31620 #

COMPLETION-FY-77-10 ..... N78-31524 #

CONF-770602-3 ..... N78-31882 #
CONF-770801-26 ..... N78-31273 #
CONF-770944-1 ..... N78-31550 #
CONF-771127-13 ..... N78-31225 #
CONF-771127-15 ..... N78-31195 #
CONF-771130-2 ..... N78-31581 #
CONF-771137-3 ..... N78-31177 #
CONF-771205-1 ..... N78-31721 #
CONF-780124-2 ..... N78-31227 #
CONF-780207-1 ..... N78-31474 #
CONF-780306-4 ..... N78-31724 #
CONF-780308-6 ..... N78-31224 #
CONF-780310-1 ..... N78-31222 #
CONF-780316-8 ..... N78-31597 #
CONF-780502-3 ..... N78-31201 #
CONF-780503-8 ..... N78-31553 #
CONF-780510-3 ..... N78-31421 #
CONF-780510-4 ..... N78-31422 #
CONF-7709106-1 ..... N78-31197 #

CONS/5082-1 ..... N78-31537*#

CONTRIB-107 ..... N78-31662*#
CONTRIB-156 ..... N78-32004*#
CONTRIB-166 ..... N78-31658 #
CONTRIB-193 ..... N78-31622 #
CONTRIB-195 ..... N78-31522 #

COO-913-67 ..... N78-31409 #
COO-1198-1193 ..... N78-31868 #
COO-2086-88 ..... N78-31200 #
COO-2617-4/1-VOL-1 ..... N78-31579 #
COO-2671-7 ..... N78-31202 #
COO-2679-14 ..... N78-31935 #
COO-2872-2 ..... N78-31223 #
COO-3084-56 ..... N78-31472 #
COO-4026-3 ..... N78-31596 #
COO-4199-1 ..... N78-31884 #

CRC-PUB-61 ..... N78-31626 #

CRREL-SR-78-6 ..... N78-31513 #

CRREL-78-3 ..... N78-31637 #

CRREL-78-4 ..... N78-31638 #
CRREL-78-6 ..... N78-31647 #
CRREL-78-10 ..... N78-31639 #

CSC/TR-77/549615 ..... N78-31804 #

D-63-1737-5335-02 ..... N78-31500*#

DAN/DT/DEV/ANL-131/72 ..... N78-31410 #

DLR-FB-77-25 ..... N78-31081 #
DLR-FB-77-30 ..... N78-31653 #
DLR-FB-77-37 ..... N78-31821 #
DLR-FB-77-38 ..... N78-31822 #
DLR-FB-77-41 ..... N78-31166 #
DLR-FB-77-42 ..... N78-31165 #
DLR-FB-77-43 ..... N78-31135 #
DLR-FB-77-45 ..... N78-31057 #
DLR-FB-77-47 ..... N78-31153 #
DLR-FB-77-51 ..... N78-31060 #
DLR-FB-77-52 ..... N78-31679 #
DLR-FB-77-53 ..... N78-31400 #
DLR-FB-77-54 ..... N78-31117 #
DLR-FB-77-55 ..... N78-31125 #
DLR-FB-77-57 ..... N78-31833 #
DLR-FB-77-58 ..... N78-31939 #
DLR-FB-77-63 ..... N78-31251 #

DLR-IB-151-77/14 ..... N78-31056 #
DLR-IB-257-78/1 ..... N78-31879 #
DLR-IB-353-78/1 ..... N78-31585 #
DLR-IB-551-76/21 ..... N78-31346 #
DLR-IB-551-77/2 ..... N78-31349 #
DLR-IB-551-77/13 ..... N78-31901 #
DLR-IB-552-77/40 ..... N78-31516 #

DNA-HAES-70 ..... N78-31643 #

DNA-4409F ..... N78-31643 #
DNA-4455F ..... N78-31648 #

DOC-E78AEG289 ..... N78-31427*#

DOC-77AEG633 ..... N78-31116 #
DOC-78SDS4202 ..... N78-31503*#

DOE/ERA-0001 ..... N78-31957 #
DOE/ERA-0002 ..... N78-31958 #
DOE/ET-0006 ..... N78-31170 #
DOE/ET-0007 ..... N78-31908 #
DOE/NASA/1040-78/1 ..... N78-31533*#
DOE/NASA/1040-78/2 ..... N78-31236*#
DOE/NASA/1040-78/3 ..... N78-31534*#
DOE/NASA/2953-78/2 ..... N78-31208*#

DOT-HS-803250-VOL-2 ..... N78-31441 #
DOT-HS-803251-VOL-3A ..... N78-31442 #
DOT-HS-803252-VOL-3B ..... N78-31443 #

DR-105 ..... N78-31828 #

DRDMI-H-78-1-VOL-1 ..... N78-31414 #

DRDMI-T-78-33 ..... N78-31796 #

DST-1850S-522-76 ..... N78-31261 #
DST-1850S-522-78 ..... N78-31261 #

DTNSRDC-78-046 ..... N78-31468 #
DTNSRDC-78/045 ..... N78-31765 #

DTNSRDC/ASED-373 ..... N78-31047 #
DTNSRDC/SPD-698-02 ..... N78-31434 #

D210-11236-1 ..... N78-31089 #
D210-11328-1 ..... N78-31114 #

E-9582 ..... N78-31384*#
E-9583 ..... N78-31213*#
E-9649 ..... N78-31210*#
E-9656 ..... N78-31533*#
E-9723 ..... N78-31236*#
E-9725 ..... N78-31208*#
E-9746 ..... N78-31211*#
E-9748 ..... N78-31690*#
E-9750 ..... N78-31323*#
E-9751 ..... N78-31212*#
E-9752 ..... N78-31534*#
E-9760 ..... N78-31061*#

E-9761 ..... N78-31954*#
E-9764 ..... N78-31871*#
E-9771 ..... N78-31155*#
E-9772 ..... N78-31209*#
E-9773 ..... N78-32014*#

ECOM-76-1301-6 ..... N78-31363 #
ECOM-77-2713-1 ..... N78-31370 #

EDD-W-07564 ..... N78-31370 #

EE-TR-78-28 ..... N78-31498*#

EE-78-4 ..... N78-31807 #

EPA-7-IA-OTTUSWA-W-NSDP-77 ..... N78-31617 #
EPA-340/1-78-002 ..... N78-31625 #
EPA-440/3-77-027 ..... N78-31616 #
EPA-450/2-77-021B ..... N78-31614 #
EPA-450/2-78-008 ..... N78-31602 #
EPA-450/2-78-010 ..... N78-31600 #
EPA-450/2-78-011 ..... N78-31601 #
EPA-550/9-78-102 ..... N78-31733 #
EPA-600/1-78-021 ..... N78-31731 #
EPA-600/2-78-014 ..... N78-31967 #
EPA-600/2-78-017 ..... N78-31965 #
EPA-600/2-78-035 ..... N78-31276 #
EPA-600/2-78-060 ..... N78-31603 #
EPA-600/3-78-024 ..... N78-31205 #
EPA-600/3-78-031 ..... N78-31611 #
EPA-600/3-78-033 ..... N78-31624 #
EPA-600/4-78-018 ..... N78-31610 #
EPA-600/5-78-005 ..... N78-31623 #
EPA-600/5-78-006A ..... N78-31521 #
EPA-600/7-77-089 ..... N78-31886 #
EPA-600/7-77-094B ..... N78-31615 #
EPA-600/7-77-147 ..... N78-31613 #
EPA-600/7-77-149 ..... N78-31605 #
EPA-600/7-78-004 ..... N78-31606 #
EPA-600/7-78-017 ..... N78-31204 #
EPA-600/7-78-030A ..... N78-31598 #
EPA-600/7-78-030B ..... N78-31599 #
EPA-600/7-78-041 ..... N78-31609 #
EPA-600/7-78-053 ..... N78-31604 #
EPA-600/8-77-017 ..... N78-31730 #
EPA-600/8-78-001 ..... N78-31962 #

EPRI-AF-528 ..... N78-31552 #

EPRI-EA-668 ..... N78-31723 #

EPRI-ER-670 ..... N78-31575 #
EPRI-ER-680 ..... N78-31577 #

EPRI-NP-676-SR ..... N78-31448 #
EPRI-NP-717 ..... N78-31230*#

ERADCOM/ASL-CR-78-0043-1 ..... N78-31673 #
ERADCOM/ASL-DR-0001 ..... N78-31671 #

ERG-022 ..... N78-31268 #
ERG-023 ..... N78-31584 #

ERIM-132400-7-L ..... N78-31505*#

ERSD-110-75-3 ..... N78-31275 #

ESA-CR(P)-1058 ..... N78-31179 #
ESA-CR(P)-1063 ..... N78-31348 #
ESA-CR(P)-1068-VOL-1 ..... N78-32024 #
ESA-CR(P)-1068-VOL-2 ..... N78-32025 #
ESA-CR(P)-1069 ..... N78-31180 #
ESA-CR(P)-1071 ..... N78-31154 #
ESA-CR(P)-1073 ..... N78-31374 #
ESA-CR(P)-1075 ..... N78-31375 #
ESA-CR(P)-1076 ..... N78-31585 #
ESA-CR(P)-1077-VOL-1 ..... N78-31252 #
ESA-CR(P)-1077-VOL-2 ..... N78-31253 #
ESA-CR(P)-1078 ..... N78-31138 #
ESA-CR(P)-1082 ..... N78-31399 #
ESA-CR(P)-1083-VOL-1 ..... N78-31350 #
ESA-CR(P)-1083-VOL-2 ..... N78-31351 #
ESA-CR(P)-1087 ..... N78-31439 #

ESA-ESTL-29 ..... N78-31439 #

ESA-SPEC-QRA-03-ISSUE-3 ..... N78-31157 #

ESA-SPEC-QRC-04-ISSUE-1-REV-1 ..... N78-31158 #

ESA-SPEC-QRC-06-ISSUE-2-REV-1 ..... N78-31376 #

ESD-TR-76-288-VOL-1 ..... N78-31764 #
ESD-TR-78-33 ..... N78-31642 #
ESD-TR-78-140 ..... N78-31809 #
ESD-TR-78066 ..... N78-32020 #

ESL-P-826 ..... N78-31859 #

ESL-TM-887 ..... N78-31145 #
ESL-TM-888 ..... N78-31144 #
ESL-TM-938 ..... N78-31147 #
ESL-TM-939 ..... N78-31146 #

ESS/SS-777 ..... N78-31138 #
ESS/SS-834 ..... N78-31154 #

ETL-0128 ..... N78-31407 #

ETS-29 ..... N78-32020 #
ETS-33 ..... N78-31642 #

E78-10180 ..... N78-31479*#
E78-10181 ..... N78-31480*#
E78-10182 ..... N78-31481*#
E78-10183 ..... N78-31482*#
E78-10184 ..... N78-31483*#
E78-10185 ..... N78-31484*#
E78-10186 ..... N78-31485*#
E78-10187 ..... N78-31486*#
E78-10188 ..... N78-31487*#
E78-10189 ..... N78-31488*#
E78-10190 ..... N78-31489*#
E78-10191 ..... N78-31490*#
E78-10192 ..... N78-31491*#
E78-10193 ..... N78-31492*#
E78-10195 ..... N78-31493*#
E78-10196 ..... N78-31494*#
E78-10197 ..... N78-31495*#
E78-10198 ..... N78-31496*#
E78-10199 ..... N78-31497*#
E78-10200 ..... N78-31498*#
E78-10201 ..... N78-31499*#
E78-10202 ..... N78-31500*#
E78-10203 ..... N78-31501*#
E78-10204 ..... N78-31502*#
E78-10205 ..... N78-31503*#
E78-10206 ..... N78-31504*#
E78-10207 ..... N78-31505*#
E78-10208 ..... N78-31506*#
E78-10209 ..... N78-31507*#

FAA-AM-78-23 ..... N78-31062 #

FAA-AUP-77-34 ..... N78-31075 #

FAA-EM-78-8 ..... N78-31130 #
FAA-EM-78-9 ..... N78-31131 #

FAA-NA-77-39 ..... N78-31325 #
FAA-NA-78-16 ..... N78-31070 #
FAA-NA-78-17 ..... N78-31071 #
FAA-NA-78-19 ..... N78-31072 #
FAA-NA-78-30 ..... N78-31132 #

FAA-RD-76-95 ..... N78-31949 #
FAA-RD-77-119 ..... N78-31669 #
FAA-RD-77-129 ..... N78-31324 #
FAA-RD-77-150 ..... N78-31074 #
FAA-RD-77-189-1-VOL-1 ..... N78-31088 #
FAA-RD-78-16 ..... N78-31070 #
FAA-RD-78-17 ..... N78-31071 #
FAA-RD-78-19 ..... N78-31072 #
FAA-RD-78-41 ..... N78-31073 #
FAA-RD-78-50 ..... N78-31256 #
FAA-RD-78-69 ..... N78-31132 #

FB-138(1978) ..... N78-31462 #

FE-1216-4 ..... N78-31554 #
FE-2210-18 ..... N78-31385 #

FJSRL-TR-78-0002 ..... N78-31881 #

FLCS-7601 ..... N78-31743 #

FOA-C-20217-E4 ..... N78-31080 #
FOA-C-20231-T1 ..... N78-31654 #
FOA-C-20232-T1 ..... N78-31655 #

FOA-C-56014-H9 ..... N78-31726 #

FR-1 ..... N78-31144 #
FR-2 ..... N78-31440 #
FR-3 ..... N78-31146 #
FR-4 ..... N78-31147 #
FR-9560 ..... N78-31113 #
FR-10200A ..... N78-31106*#

FRA/ORD-78/02 ..... N78-31744 #

FR77-14-763 ..... N78-31339 #

FSRP-FPL-306 ..... N78-31469 #

FSU-STATISTICS-M458 ..... N78-31855 #

FUB-25-1977 ..... N78-31811 #

FWS/OBS-77/3 ..... N78-31688 #

G-7802-F15 ..... N78-31413*#

GA-A-14807 ..... N78-31573 #
GA-A-14848 ..... N78-31891 #

GCS/EE/77-7 ..... N78-31830 #

GJBX-2-78-VOL-1 ..... N78-31650 #

GPO-20-025 ..... N78-31666 #
GPO-20-083 ..... N78-31542 #
GPO-23-600 ..... N78-31956 #
GPO-30-531 ..... N78-32035 #
GPO-30-920 ..... N78-31137 #
GPO-92-323 ..... N78-31670 #
GPO-96-834 ..... N78-31543 #
GPO-98-931 ..... N78-31076 #

GSA/FPA/MCL-TM-262 ..... N78-31813 #

HCM-028 ..... N78-31493*#

HCP/T2068-1 ..... N78-31372 #

HDC-CR-070-1 ..... N78-31934 #

HEDL-SA-1348 ..... N78-31445 #

HEDL-TME-77-91 ..... N78-31435 #

HEP-37 ..... N78-31943 #

HH-77-307 ..... N78-31119 #

HONEYWELL-47305 ..... N78-31927 #

HSER-7342 ..... N78-31952 #

HUMRRO-FR-ED-77-25 ..... N78-31734 #

IAEA-SM-224/201 ..... N78-31724 #

ICAF-1045 ..... N78-31460 #
ICAF-1046 ..... N78-31461 #
ICAF-1047 ..... N78-31462 #

IDO-1549-8 ..... N78-31578 #

IIEQ-77/37 ..... N78-31964 #

IIT-FLUIDS/HEAT-TRANS-R77-1 ..... N78-31408 #

ILB-22 ..... N78-31397 #

INPE-1007-NTE/078 ..... N78-31492*#
INPE-1008-RRE/031 ..... N78-31479*#
INPE-1009-NTE/079 ..... N78-31491*#
INPE-1010-NTE/080 ..... N78-31490*#
INPE-1011-NTE/081 ..... N78-31489*#
INPE-1012-NTE/082 ..... N78-31488*#
INPE-1013-NTE/083 ..... N78-31487*#
INPE-1054-NTE/091 ..... N78-31486*#
INPE-1063-NTE/098 ..... N78-31791 #
INPE-1151-PE/103 ..... N78-31482*#
INPE-1223-PE/125 ..... N78-31481*#
INPE-1228-NTE/116 ..... N78-31485*#
INPE-1279-NTE/122 ..... N78-31484*#
INPE-1286-PE/140 ..... N78-31480*#

INPE-1289-NTE/124 ..... N78-31483*#

IR-1 ..... N78-31370 #
IR-6 ..... N78-31363 #

IS-T-786 ..... N78-31196 #
IS-T-802 ..... N78-31193 #

ISBN-3-7983-0591-9 ..... N78-31397 #
ISBN-92-63-10494-8 ..... N78-31676 #
ISBN-92-63-10500-6 ..... N78-31677 #
ISBN-92-835-0216-7 ..... N78-31279 #
ISBN-92-835-1284-7 ..... N78-31661 #
ISBN-92-835-1285-5 ..... N78-31745 #
ISBN-92-835-1288-X ..... N78-31401 #
ISBN-92-835-1290-1 ..... N78-31126 #

ISSN-0575-4941 ..... N78-31658 #

ISU-ERI-AMES-78173 ..... N78-31118 #

JPL-PUB-78-64 ..... N78-32032*#
JPL-PUB-78-66-VOL-1 ..... N78-31511*#
JPL-PUB-78-66-VOL-2 ..... N78-31512*#
JPL-PUB-78-69 ..... N78-31237*#
JPL-PUB-78-71-VOL-1 ..... N78-31428*#
JPL-PUB-78-71-VOL-2 ..... N78-31429*#
JPL-PUB-78-76 ..... N78-31541*#
JPL-PUB-78-85 ..... N78-32018*#

JPRS-71467 ..... N78-31694 #
JPRS-71569 ..... N78-31697 #
JPRS-71595 ..... N78-31705 #

JSC-13886 ..... N78-31509*#

KNMI-141-23 ..... N78-31678 #

KU-FRL-317-8 ..... N78-31873*#
KU-FRL-317-9 ..... N78-31874*#

L-12046 ..... N78-31792*#
L-12106 ..... N78-31793*#
L-12197 ..... N78-31101*#
L-12215 ..... N78-31045*#
L-12219 ..... N78-31043*#
L-12277 ..... N78-31044*#
L-12278 ..... N78-31404*#
L-12286 ..... N78-31354*#
L-12287 ..... N78-31836*#

LA-TR-77-52 ..... N78-31265 #
LA-TR-78-23 ..... N78-31410 #

LA-UR-77-2805 ..... N78-31581 #
LA-UR-78-681 ..... N78-31724 #
LA-UR-78-707 ..... N78-31553 #

LA-7106-MS ..... N78-31936 #
LA-7158 ..... N78-31267 #

LARS-TR-061778 ..... N78-31498*#

LBL-5679 ..... N78-31721 #
LBL-6199 ..... N78-31938 #
LBL-6525 ..... N78-31882 #
LBL-6931 ..... N78-31225 #
LBL-6985 ..... N78-31177 #
LBL-7233 ..... N78-31199 #
LBL-7322 ..... N78-31937 #
LBL-7344 ..... N78-31885 #
LBL-7366 ..... N78-31227 #

LBR-1501 ..... N78-31544 #

LC-77-10824 ..... N78-31589 #
LC-77-20344 ..... N78-31626 #
LC-78-606033 ..... N78-31607*#

LEC-11863 ..... N78-31501*#
LEC-12174 ..... N78-31500*#

LNSC-D566309 ..... N78-31643 #

LR-28272-VOL-2 ..... N78-31430 #
LR-28307-VOL-1 ..... N78-31088 #
LR-28384-VOL-1 ..... N78-31085*#

M-260 ..... N78-31740*#

MDC-G7330 ..... N78-31465*#

MDC-J7895 ..... N78-31387 #

MIT-TR-202 ..... N78-31389 #

MRC-R-7731-1-278 ..... N78-31673 #

MR177-FR-1511 ..... N78-31609 #

MSA-13 ..... N78-31677 #

MSC/TFR/802/1151 ..... N78-31175 #

MTI-76TR41-VOL-1 ..... N78-31111 #

MTR-3178-VOL-1 ..... N78-31764 #
MTR-7599 ..... N78-31961 #
MTR-7692 ..... N78-31744 #
MTR-7766 ..... N78-31130 #
MTR-7837 ..... N78-31131 #

MUJWBRC-88 ..... N78-31520 #

NA-77-938 ..... N78-31064 #

NADC-13920-2 ..... N78-31098 #

NAEC-92-122 ..... N78-31063 #

NAPTC-PE-106 ..... N78-31105*#

NASA-CASE-ARC-11008-1 ..... N78-31232*
NASA-CASE-ARC-11057-1 ..... N78-31233*
NASA-CASE-ARC-11058-1 ..... N78-31735*
NASA-CASE-ARC-11100-1 ..... N78-31736*

NASA-CASE-GSC-11883-2 ..... N78-31426*

NASA-CASE-LAR-11690-1 ..... N78-31406*#

NASA-CASE-LEW-12131-2 ..... N78-31103*#

NASA-CASE-MSC-18179-1 ..... N78-31162*#
NASA-CASE-MSC-19706-1 ..... N78-31129*

NASA-CASE-NPO-13581-2 ..... N78-31525*
NASA-CASE-NPO-13813-1 ..... N78-31526*
NASA-CASE-NPO-13914-1 ..... N78-31526*
NASA-CASE-NPO-13937-1 ..... N78-31527*
NASA-CASE-NPO-14022-1 ..... N78-31321*
NASA-CASE-NPO-14103-1 ..... N78-31255*

NASA-CR-2992 ..... N78-31876*#
NASA-CR-3010 ..... N78-31818*#
NASA-CR-3026 ..... N78-31465*#
NASA-CR-135304 ..... N78-31105*#
NASA-CR-135319 ..... N78-31238*#
NASA-CR-135411 ..... N78-31427*#
NASA-CR-135416-VOL-1 ..... N78-31141*#
NASA-CR-135416-VOL-2 ..... N78-31142*#
NASA-CR-135444 ..... N78-31108*#
NASA-CR-145369-VOL-1 ..... N78-31085*#
NASA-CR-145369-VOL-2 ..... N78-31086*#
NASA-CR-145371 ..... N78-31794*#
NASA-CR-150699 ..... N78-31538*#
NASA-CR-150726 ..... N78-31507*#
NASA-CR-150741 ..... N78-31536*#
NASA-CR-150770 ..... N78-31532*#
NASA-CR-150771 ..... N78-31535*#
NASA-CR-150776 ..... N78-31663*#
NASA-CR-150777 ..... N78-31664*#
NASA-CR-150778 ..... N78-31632*#
NASA-CR-150779 ..... N78-31665*#
NASA-CR-150789 ..... N78-31353*#
NASA-CR-150790 ..... N78-31713*#
NASA-CR-150791 ..... N78-31159*#
NASA-CR-150792 ..... N78-31160*#
NASA-CR-150793 ..... N78-31161*#
NASA-CR-150796 ..... N78-31163*#
NASA-CR-150797 ..... N78-31531*#
NASA-CR-150798 ..... N78-31763*#
NASA-CR-150807 ..... N78-31825*#
NASA-CR-150809 ..... N78-31795*#
NASA-CR-150810 ..... N78-31412*#
NASA-CR-150811 ..... N78-31464*#
NASA-CR-151754 ..... N78-31505*#
NASA-CR-151809 ..... N78-31500*#
NASA-CR-151813 ..... N78-31501*#
NASA-CR-151820 ..... N78-31504*#
NASA-CR-151827 ..... N78-31498*#
NASA-CR-156800 ..... N78-31503*#
NASA-CR-156812 ..... N78-31540*#
NASA-CR-156813 ..... N78-31819*#
NASA-CR-157360 ..... N78-31234*#
NASA-CR-157370 ..... N78-31479*#
NASA-CR-157371 ..... N78-31480*#
NASA-CR-157372 ..... N78-31481*#
NASA-CR-157373 ..... N78-31482*#
NASA-CR-157374 ..... N78-31483*#
NASA-CR-157375 ..... N78-31484*#
NASA-CR-157376 ..... N78-31485*#
NASA-CR-157377 ..... N78-31486*#
NASA-CR-157378 ..... N78-31487*#
NASA-CR-157379 ..... N78-31488*#
NASA-CR-157380 ..... N78-31489*#
NASA-CR-157381 ..... N78-31490*#
NASA-CR-157382 ..... N78-31491*#
NASA-CR-157383 ..... N78-31492*#
NASA-CR-157385 ..... N78-31493*#
NASA-CR-157386 ..... N78-31494*#
NASA-CR-157387 ..... N78-31495*#
NASA-CR-157388 ..... N78-31497*#
NASA-CR-157390 ..... N78-31502*#
NASA-CR-157571 ..... N78-31714*#
NASA-CR-157572 ..... N78-31466*#
NASA-CR-157573 ..... N78-31403*#
NASA-CR-157574 ..... N78-31662*#
NASA-CR-157575 ..... N78-31383*#
NASA-CR-157577 ..... N78-31230*#
NASA-CR-157578 ..... N78-31107*#
NASA-CR-157579 ..... N78-31459*#
NASA-CR-157580 ..... N78-31067*#
NASA-CR-157581 ..... N78-31069*#
NASA-CR-157582 ..... N78-31068*#
NASA-CR-157587 ..... N78-31874*#
NASA-CR-157588 ..... N78-31873*#
NASA-CR-157589 ..... N78-31872*#
NASA-CR-157591 ..... N78-31691*#
NASA-CR-157592 ..... N78-32027*#
NASA-CR-157593 ..... N78-31428*#
NASA-CR-157594 ..... N78-31429*#
NASA-CR-157595 ..... N78-32032*#
NASA-CR-157598 ..... N78-32018*#
NASA-CR-157599 ..... N78-31541*#
NASA-CR-157600 ..... N78-31511*#
NASA-CR-157601 ..... N78-31512*#
NASA-CR-157610 ..... N78-31607*#
NASA-CR-158934 ..... N78-31140*#
NASA-CR-159398 ..... N78-31537*#
NASA-CR-159402 ..... N78-31106*#
NASA-CR-159403 ..... N78-31235*#
NASA-CR-159404 ..... N78-31380*#
NASA-CR-159410 ..... N78-31143*#

NASA-SP-427 ..... N78-31508*#
NASA-SP-7011(183) ..... N78-31712*+
NASA-SP-7037(98) ..... N78-31041*+
NASA-SP-7041(18) ..... N78-31478*+
NASA-SP-7043(17) ..... N78-31530*+
NASA-SP-8125 ..... N78-31164*#

NASA-TM-58208 ..... N78-31509*#
NASA-TM-78063 ..... N78-31667*#
NASA-TM-78189 ..... N78-31381*#
NASA-TM-78190 ..... N78-31405*#
NASA-TM-78191 ..... N78-31382*#
NASA-TM-78524 ..... N78-32029*#
NASA-TM-78664 ..... N78-31043*#
NASA-TM-78670 ..... N78-31792*#
NASA-TM-78701 ..... N78-31793*#
NASA-TM-78729 ..... N78-31044*#
NASA-TM-78734 ..... N78-31404*#
NASA-TM-78740 ..... N78-31354*#
NASA-TM-78879 ..... N78-31209*#
NASA-TM-78919 ..... N78-31533*#
NASA-TM-78960 ..... N78-31210*#
NASA-TM-78965 ..... N78-31236*#
NASA-TM-78966 ..... N78-31208*#
NASA-TM-78973 ..... N78-31211*#
NASA-TM-78974 ..... N78-31690*#
NASA-TM-78975 ..... N78-31323*#
NASA-TM-78976 ..... N78-31212*#
NASA-TM-78977 ..... N78-31534*#
NASA-TM-78983 ..... N78-31061*#
NASA-TM-78984 ..... N78-31954*#
NASA-TM-78986 ..... N78-31871*#

NASA-TM-78989 ..... N78-31155*#
NASA-TM-78990 ..... N78-32014*#
NASA-TM-79570 ..... N78-32034*#
NASA-TM-79571 ..... N78-32028*#
NASA-TM-79583 ..... N78-31633*#
NASA-TM-79603 ..... N78-31634*#
NASA-TM-79612 ..... N78-31539*#
NASA-TM-79614 ..... N78-31635*#
NASA-TM-79616 ..... N78-31355*#
NASA-TM-79617 ..... N78-31510*#
NASA-TM-79618 ..... N78-31960*#
NASA-TM-79619 ..... N78-31971*#
NASA-TM-79623 ..... N78-32031*#
NASA-TM-79625 ..... N78-32016*#
NASA-TM-79626 ..... N78-32017*#
NASA-TM-79742 ..... N78-31496*#
NASA-TM-79743 ..... N78-31499*#
NASA-TM-79744 ..... N78-31506*#

NASA-TP-1252 ..... N78-31045*#
NASA-TP-1255 ..... N78-31739*#
NASA-TP-1276 ..... N78-31101*#
NASA-TP-1282 ..... N78-31836*#
NASA-TP-1297 ..... N78-31384*#
NASA-TP-1308 ..... N78-31213*#
NASA-TP-1310 ..... N78-31109*#
NASA-TP-1311 ..... N78-31854*#
NASA-TP-1313 ..... N78-31740*#
NASA-TP-1315 ..... N78-31413*#

NATC-TM-78-2-SA ..... N78-31046 #

NBS-SP-500-31 ..... N78-31823 #
NBS-SP-500-32 ..... N78-31772 #
NBS-SP-503 ..... N78-31812 #
NBS-SP-513 ..... N78-31607*#

NBSIR-77-1380 ..... N78-31378 #
NBSIR-77-1437 ..... N78-31444 #
NBSIR-78-1422 ..... N78-31254 #
NBSIR-78-1429 ..... N78-31219 #
NBSIR-78-1457 ..... N78-31079 #

NEPP-7-VOL-2 ..... N78-31587 #

NLR-MP-77019-U ..... N78-31463 #

NLR-TR-76086-U-PT-2 ..... N78-31398 #

NOAA-TM-EDS-NGSDC-4 ..... N78-31657 #

NOAA-TM-ERL-NSSL-82 ..... N78-31277 #

NOAA-TR-ERL-390 ..... N78-31686 #

NOAA-77101712 ..... N78-31683 #
NOAA-78022703 ..... N78-31687 #
NOAA-78032402 ..... N78-31660 #
NOAA-78041207 ..... N78-31684 #
NOAA-78041218 ..... N78-31686 #
NOAA-78041227 ..... N78-31657 #
NOAA-78042008 ..... N78-31277 #

NOSC/TD-138 ..... N78-31805 #
NOSC/TR-231 ..... N78-31331 #

NP-23162 ..... N78-31583 #

NPI-E-77-12 ..... N78-31278 #

NPS-61-78-002 ..... N78-31592 #
NPS-69-78-011 ..... N78-31392 #

NRL-8160 ..... N78-31344 #
NRL-8227-PT-1 ..... N78-31336 #

NSF/RA-770457 ..... N78-31588 #
NSF/RA-770514 ..... N78-31626 #
NSF/RA-780045 ..... N78-31656 #
NSF/RA-780046 ..... N78-31621 #
NSF/RA-780061 ..... N78-31970 #

NSRDS-NBS-61-PT-1 ..... N78-31589 #

NSWC/DL-TR-3773 ..... N78-31152 #
NSWC/DL-TR-3790 ..... N78-31766 #
NSWC/DL-TR-3829 ..... N78-31053 #
NSWC/WOL/TR-77-182 ..... N78-31931 #

NTIS/PS-75/146 ..... N78-31959 #
NTIS/PS-75/170 ..... N78-31732 #
NTIS/PS-75/247 ..... N78-31377 #
NTIS/PS-75/390 ..... N78-31274 #
NTIS/PS-75/396 ..... N78-31693 #
NTIS/PS-75/399 ..... N78-31424 #
NTIS/PS-75/400 ..... N78-31352 #
NTIS/PS-75/444 ..... N78-31620 #
NTIS/PS-75/500 ..... N78-31947 #
NTIS/PS-76/0204 ..... N78-31775 #
NTIS/PS-76/0204 ..... N78-31776 #
NTIS/PS-76/0285 ..... N78-31066 #
NTIS/PS-76/0304 ..... N78-31959 #
NTIS/PS-76/0347 ..... N78-31732 #
NTIS/PS-76/0368 ..... N78-31377 #
NTIS/PS-76/0370 ..... N78-31693 #
NTIS/PS-76/0377 ..... N78-31274 #
NTIS/PS-76/0380 ..... N78-31352 #
NTIS/PS-76/0383 ..... N78-31424 #
NTIS/PS-76/0424 ..... N78-31451 #
NTIS/PS-76/0445 ..... N78-31379 #
NTIS/PS-76/0470 ..... N78-31620 #
NTIS/PS-76/0540 ..... N78-31947 #
NTIS/PS-77/0327 ..... N78-31775 #
NTIS/PS-77/0328 ..... N78-31776 #
NTIS/PS-77/0329 ..... N78-31778 #
NTIS/PS-77/0402 ..... N78-31453 #
NTIS/PS-77/0404 ..... N78-31451 #
NTIS/PS-77/0413 ..... N78-31693 #
NTIS/PS-77/0422 ..... N78-31959 #
NTIS/PS-77/0435 ..... N78-31424 #
NTIS/PS-77/0456 ..... N78-31732 #
NTIS/PS-77/0469 ..... N78-31274 #
NTIS/PS-77/0486 ..... N78-31377 #
NTIS/PS-77/0498 ..... N78-31066 #
NTIS/PS-77/0517 ..... N78-31379 #
NTIS/PS-77/0518 ..... N78-31620 #
NTIS/PS-77/0520 ..... N78-31586 #
NTIS/PS-77/0530 ..... N78-31352 #
NTIS/PS-77/0541 ..... N78-31619 #
NTIS/PS-77/0580 ..... N78-31947 #
NTIS/PS-78/0516/1 ..... N78-31424 #
NTIS/PS-78/0527/8 ..... N78-31274 #
NTIS/PS-78/0529/4 ..... N78-31959 #
NTIS/PS-78/0539/3 ..... N78-31066 #
NTIS/PS-78/0540/1 ..... N78-31732 #
NTIS/PS-78/0550/0 ..... N78-31693 #
NTIS/PS-78/0565/8 ..... N78-31452 #
NTIS/PS-78/0566/6 ..... N78-31453 #
NTIS/PS-78/0567/4 ..... N78-31450 #
NTIS/PS-78/0568/2 ..... N78-31451 #
NTIS/PS-78/0579/9 ..... N78-31377 #
NTIS/PS-78/0580/7 ..... N78-31379 #
NTIS/PS-78/0581/5 ..... N78-31352 #
NTIS/PS-78/0586/4 ..... N78-31586 #
NTIS/PS-78/0604/5 ..... N78-31619 #
NTIS/PS-78/0605/2 ..... N78-31947 #
NTIS/PS-78/0609/4 ..... N78-31773 #
NTIS/PS-78/0610 ..... N78-31778 #
NTIS/PS-78/0611/0 ..... N78-31774 #
NTIS/PS-78/0612/8 ..... N78-31775 #
NTIS/PS-78/0613/6 ..... N78-31776 #
NTIS/PS-78/0614/4 ..... N78-31777 #
NTIS/PS-78/0615/1 ..... N78-31778 #
NTIS/PS-78/0616/9 ..... N78-31779 #
NTIS/PS-78/0623/5 ..... N78-31618 #
NTIS/PS-78/0634/2 ..... N78-31620 #

NU-SML-TR-78-1 ..... N78-31470 #

NUREG/CR-0008 ..... N78-31394 #

NUSC-TM-78-2012 ..... N78-31432 #

NWC-TP-5983-PT-2 ..... N78-31239 #
NWC-TP-6006 ..... N78-31741 #
NWC-TP-6022 ..... N78-31257 #

NWHC-7760 ..... N78-31433 #

ORAU/IEA(M)-77-29 ..... N78-31890 #
ORAU/IEA(O)-77-31 ..... N78-31892 #
ORAU/IEA(R)-77-28 ..... N78-31889 #

ORNL-CSD-TM-40 ..... N78-31674 #

ORNL-TM-5493 ..... N78-31178 #

ORNL-TM-5875-V3 ..... N78-31722 #
ORNL-TM-6083 ..... N78-31515 #
ORNL-TM-6128 ..... N78-31228 #

ORNL-5380 ..... N78-31473 #

ORO-3992-307 ..... N78-31942 #
ORO-4180-7 ..... N78-31514 #
ORO-5005-16 ..... N78-31423 #
ORO-5159-10 ..... N78-31582 #
ORO-5260-1 ..... N78-31907 #

OSU-263 ..... N78-32027*#

OWRT-A-040-ALA(1) ..... N78-31968 #
OWRT-A-075-KAN(1) ..... N78-31522 #

OWRT-B-061-RI(4) ..... N78-31966 #
OWRT-B-115-MO(2) ..... N78-31608 #

OWRT-C-6-007(5200)(5) ..... N78-31622 #

PANA-AIR-2 ..... N78-31646 #
PANA-AIR-3 ..... N78-32033 #

PB-279616/7 ..... N78-31518 #
PB-279657/1 ..... N78-31659 #
PB-279679/5 ..... N78-31440 #
PB-279701/7 ..... N78-31517 #
PB-279772/8 ..... N78-31519 #
PB-279834/6 ..... N78-31729 #
PB-279845/2 ..... N78-31961 #
PB-279846/0 ..... N78-31744 #
PB-279856/9 ..... N78-31658 #
PB-279859/3 ..... N78-31813 #
PB-279873/4 ..... N78-31610 #
PB-279910/4 ..... N78-31204 #
PB-279921/1 ..... N78-31823 #
PB-279922/9 ..... N78-31963 #
PB-279924/5 ..... N78-31953 #
PB-279939/3 ..... N78-31772 #
PB-279999/7 ..... N78-31604 #
PB-280027/4 ..... N78-31254 #
PB-280034/0 ..... N78-31612 #
PB-280037/3 ..... N78-31587 #
PB-280048/0 ..... N78-31603 #
PB-280050/6 ..... N78-31611 #
PB-280058/9 ..... N78-31614 #
PB-280060/5 ..... N78-31861 #
PB-280071/2 ..... N78-31378 #
PB-280083/7 ..... N78-31656 #
PB-280114/0 ..... N78-31444 #
PB-280126/4 ..... N78-31613 #
PB-280143/9 ..... N78-31962 #
PB-280149/6 ..... N78-31205 #
PB-280151/2 ..... N78-31943 #
PB-280153/8 ..... N78-31441 #
PB-280154/6 ..... N78-31442 #
PB-280155/3 ..... N78-31443 #
PB-280165/2 ..... N78-31588 #
PB-280184/3 ..... N78-31600 #
PB-280185/0 ..... N78-31601 #
PB-280186/8 ..... N78-31602 #
PB-280191/8 ..... N78-31449 #
PB-280192/6 ..... N78-31944 #
PB-280198/3 ..... N78-31609 #
PB-280199/1 ..... N78-31615 #
PB-280203/1 ..... N78-31606 #
PB-280237/9 ..... N78-31886 #
PB-280253/6 ..... N78-31598 #
PB-280254/4 ..... N78-31599 #
PB-280279/1 ..... N78-31685 #
PB-280304/7 ..... N78-31946 #
PB-280316/1 ..... N78-31082 #
PB-280335/1 ..... N78-31733 #
PB-280369/0 ..... N78-31617 #
PB-280370/8 ..... N78-31812 #
PB-280374/0 ..... N78-31605 #
PB-280411/0 ..... N78-31730 #
PB-280413/6 ..... N78-31731 #
PB-280475/5 ..... N78-31728 #
PB-280479/7 ..... N78-31727 #
PB-280500/0 ..... N78-31622 #
PB-280544/8 ..... N78-31621 #
PB-280549/7 ..... N78-31607*#
PB-280551/3 ..... N78-31965 #
PB-280560/4 ..... N78-31522 #
PB-280561/2 ..... N78-31523 #
PB-280562/0 ..... N78-31964 #

PB-280578/6 ..... N78-31520 #
PB-280580/2 ..... N78-31608 #
PB-280625/5 ..... N78-31616 #
PB-280747/7 ..... N78-31660 #
PB-280750/1 ..... N78-31521 #
PB-280757/6 ..... N78-31623 #
PB-280787/3 ..... N78-31278 #
PB-280795/6 ..... N78-31589 #
PB-280927/5 ..... N78-31276 #
PB-280965/5 ..... N78-31969 #
PB-280968/9 ..... N78-31524 #
PB-280970/5 ..... N78-31968 #
PB-280971/3 ..... N78-31275 #
PB-280975/4 ..... N78-31625 #
PB-280982/0 ..... N78-31967 #
PB-280983/8 ..... N78-31624 #
PB-280989/5 ..... N78-31966 #
PB-281089/3 ..... N78-31688 #
PB-281098/4 ..... N78-31687 #
PB-281158/6 ..... N78-31079 #
PB-281388/9 ..... N78-31683 #
PB-281390/5 ..... N78-31684 #
PB-281459/8 ..... N78-31657 #
PB-281460/6 ..... N78-31686 #
PB-281860/7 ..... N78-31277 #
PB-282155/1 ..... N78-31626 #
PB-282159/3 ..... N78-31970 #

PHL-1977-39 ..... N78-31373 #

PMEL-28 ..... N78-31686 #

PNL-2463 ..... N78-31394 #

PPSP/NMC/CC-77/1 ..... N78-31685 #

PR-4 ..... N78-31194 #
PR-18 ..... N78-31473 #

PRL-152 ..... N78-31191 #

PRRL-77-CR-38 ..... N78-31361 #

PSAD-78-36 ..... N78-31946 #
PSAD-78-37 ..... N78-31082 #
PSAD-78-58 ..... N78-31517 #

PT-5228 ..... N78-31143*#

PUBL-89 ..... N78-31524 #
PUBL-161 ..... N78-31395 #
PUBL-164 ..... N78-31396 #
PUBL-1111 ..... N78-31515 #

PWA-FR-10097 ..... N78-31174 #

PWA-5141 ..... N78-31174 #

QR-2 ..... N78-31360 #
QR-4 ..... N78-31368 #
QR-4 ..... N78-31532*#

QTR-4918-245-VOL-1 ..... N78-31159*#
QTR-4918-245-VOL-1-SECT-2 ..... N78-31160*#
QTR-4918-245-VOL-2 ..... N78-31161*#

R-1140-VOL-1 ..... N78-31818*#

RADC-TR-78-43-VOL-1 ..... N78-31950 #
RADC-TR-78-50-VOL-2 ..... N78-31827 #
RADC-TR-78-59-VOL-1 ..... N78-31826 #
RADC-TR-78-71 ..... N78-31359 #
RADC-TR-78-82 ..... N78-31328 #
RADC-TR-78-87 ..... N78-31641 #
RADC-TR-78-89 ..... N78-31342 #
RADC-TR-78-92 ..... N78-31334 #
RADC-TR-78-97 ..... N78-31367 #
RADC-TR-78-101 ..... N78-31828 #
RADC-TR-78-106 ..... N78-31341 #
RADC-TR-78-121 ..... N78-31343 #

RAE-LIB-TRANS-1917 ..... N78-31738 #
RAE-LIB-TRANS-1948 ..... N78-31087 #
RAE-LIB-TRANS-1963 ..... N78-31877 #
RAE-LIB-TRANS-1967 ..... N78-31207 #

RAE-TR-74172 ..... N78-31055 #
RAE-TR-77132 ..... N78-31845 #
RAE-TR-77175 ..... N78-31059 #

RAND/R-2243-AF ..... N78-31100 #

RDR-1831-23 ..... N78-31238*#

REPT-2 ..... N78-31145 #
REPT-7 ..... N78-31523 #
REPT-23 ..... N78-31636 #
REPT-70 ..... N78-31504*#
REPT-78-1 ..... N78-31714*#
REPT-78-066 ..... N78-31763*#
REPT-78-084 ..... N78-31795*#
REPT-163 ..... N78-31496*#
REPT-196 ..... N78-31270 #
REPT-1343-01-1-1753 ..... N78-31134 #
REPT-1708-01-1-1762 ..... N78-31093 #
REPT-3778-12 ..... N78-31603 #
REPT-24655-VOL-1 ..... N78-31356 #
REPT-24655-VOL-2 ..... N78-31357 #
REPT-24655-VOL-3 ..... N78-31358 #
REPT-28410 ..... N78-31495*#
REPT-29817-6001-T0-00 ..... N78-31353*#
REPT-32999-81 ..... N78-31163*#

RHO-SA-33 ..... N78-31597 #

RLO-2342-77/2 ..... N78-31675 #

RM-653 ..... N78-31112 #

RPI-CS-77-3 ..... N78-31215 #
RPI-CS-78-1 ..... N78-31216 #
RPI-CS-78-2 ..... N78-31214 #

RR-2-77 ..... N78-31343 #
RR-78-1 ..... N78-31860 #

RTI-1266-06-01F ..... N78-31944 #

R78AEG017 ..... N78-31115 #
R78AEG510 ..... N78-31108*#
R78EMH5 ..... N78-31467 #

S-2333 ..... N78-31928 #

SAI-77-918-LJ ..... N78-31648 #

SAM-TR-77-31 ..... N78-31743 #

SAM-34P218X4 ..... N78-31194 #
SAM-1099-1 ..... N78-31436 #
SAM-1109-8/9-VOL-7 ..... N78-31574 #

SAND-77-1375 ..... N78-31580 #
SAND-77-1429C ..... N78-31201 #
SAND-77-1556 ..... N78-31229 #
SAND-77-2070 ..... N78-31176 #
SAND-77-8510 ..... N78-31550 #
SAND-78-6005 ..... N78-31883 #
SAND-78-8212 ..... N78-31099 #
SAND-78-8668 ..... N78-31054 #

SDC-TM-5772/007/02 ..... N78-31809 #

SE-10 ..... N78-31660 #

SERIAL-T-369 ..... N78-31447 #

SN-8320-F ..... N78-31235*#

SORI-EAS-77-731 ..... N78-31603 #

SRD-77-185 ..... N78-31729 #
SRD-78-051 ..... N78-31930 #

SU-TF-12 ..... N78-31383*#

TB-127(1978) ..... N78-31461 #

TCRL-10 ..... N78-31118 #

TDCK-69741 ..... N78-31373 #

TI-03-77-46 ..... N78-31368 #

TID-28279 ..... N78-31393 #
TID-28291 ..... N78-31576 #

TM-59 ..... N78-31067*#
TM-60 ..... N78-31068*#
TM-61 ..... N78-31069*#
TM-77-243 ..... N78-31391 #
TM-77-327 ..... N78-31271 #

TPS-75-620 ..... N78-31448 #

TR-1 ..... N78-31244 #
TR-2 ..... N78-31770 #
TR-4 ..... N78-31168 #
TR-6-AFOSR ..... N78-31855 #
TR-7 ..... N78-31217 #
TR-8 ..... N78-31219 #
TR-9 ..... N78-31769 #
TR-12 ..... N78-31190 #
TR-19 ..... N78-31246 #
TR-20 ..... N78-31837 #
TR-21 ..... N78-31169 #
TR-48 ..... N78-31831 #
TR-63 ..... N78-31842 #
TR-78-2 ..... N78-31220 #
TR-78-1300 ..... N78-31464*#
TR-123 ..... N78-31446 #
TR-267 ..... N78-31332 #
TR-0078(3606)-1 ..... N78-31390 #
TR-7615 ..... N78-31048 #

TSC-PD-B525-1-VOL-1 ..... N78-31826 #
TSC-PD-B525-1-VOL-2 ..... N78-31827 #

TVA-EP/78-02 ..... N78-31886 #

UCB/AM-77-8 ..... N78-31940 #

UCI-ARTR-78-2 ..... N78-31594 #

UCID-17558-PT-1 ..... N78-31549 #
UCID-17652 ..... N78-31266 #
UCID-17696 ..... N78-31226 #
UCID-17747 ..... N78-31371 #
UCID-17760 ..... N78-31843 #

UCLA-ENG-7758 ..... N78-31449 #

UCRL-TRANS-11330 ..... N78-31411 #

UCRL-52366 ..... N78-31652 #
UCRL-52375 ..... N78-31475 #
UCRL-80478 ..... N78-31474 #
UCRL-80490 ..... N78-31422 #
UCRL-80495 ..... N78-31421 #

UDR-TR-78-67-VOL-1 ..... N78-31141*#
UDR-TR-78-67-VOL-2 ..... N78-31142*#

UDRI-TR-77-27 ..... N78-31243 #

UILU-WRC-77-0007 ..... N78-31523 #

UNCEES-REF-77-91-CBL ..... N78-31685 #

URI/GSO-REF-78-1 ..... N78-31682 #

US-PATENT-APPL-SN-590975 ..... N78-31525*
US-PATENT-APPL-SN-596787 ..... N78-31426*
US-PATENT-APPL-SN-708951 ..... N78-31232*
US-PATENT-APPL-SN-718137 ..... N78-31527*
US-PATENT-APPL-SN-747675 ..... N78-31426*
US-PATENT-APPL-SN-753965 ..... N78-31735*
US-PATENT-APPL-SN-765139 ..... N78-31526*
US-PATENT-APPL-SN-767911 ..... N78-31129*
US-PATENT-APPL-SN-780569 ..... N78-31736*
US-PATENT-APPL-SN-780728 ..... N78-31321*
US-PATENT-APPL-SN-797210 ..... N78-31255*
US-PATENT-APPL-SN-807762 ..... N78-31233*
US-PATENT-APPL-SN-811815 ..... N78-31525*
US-PATENT-APPL-SN-928129 ..... N78-31406*#
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US-PATENT-CLASS-2-2.1A ..... N78-31736*
US-PATENT-CLASS-44-1R ..... N78-31527*
US-PATENT-CLASS-44-2 ..... N78-31527*
US-PATENT-CLASS-60-527 ..... N78-31426*
US-PATENT-CLASS-73-147 ..... N78-31129*
US-PATENT-CLASS-74-100R ..... N78-31426*
US-PATENT-CLASS-126-270 ..... N78-31526*
US-PATENT-CLASS-126-271 ..... N78-31525*

US-PATENT-CLASS-126-271 ..... N78-31526*
US-PATENT-CLASS-149-19.4 ..... N78-31255*
US-PATENT-CLASS-149-19.8 ..... N78-31255*
US-PATENT-CLASS-149-88 ..... N78-31255*
US-PATENT-CLASS-149-92 ..... N78-31255*
US-PATENT-CLASS-149-93 ..... N78-31255*
US-PATENT-CLASS-149-105 ..... N78-31255*
US-PATENT-CLASS-149-111 ..... N78-31255*
US-PATENT-CLASS-201-17 ..... N78-31527*
US-PATENT-CLASS-237-1A ..... N78-31525*
US-PATENT-CLASS-239-265.25 ..... N78-31129*
US-PATENT-CLASS-260-2.5N ..... N78-31232*
US-PATENT-CLASS-260-47CP ..... N78-31232*
US-PATENT-CLASS-260-63N ..... N78-31232*
US-PATENT-CLASS-260-78.41 ..... N78-31232*
US-PATENT-CLASS-285-235 ..... N78-31735*
US-PATENT-CLASS-343-781CA ..... N78-31321*
US-PATENT-CLASS-343-782 ..... N78-31321*
US-PATENT-CLASS-343-837 ..... N78-31321*
US-PATENT-CLASS-350-165 ..... N78-31233*
US-PATENT-CLASS-350-175NG ..... N78-31233*
US-PATENT-CLASS-350-299 ..... N78-31526*
US-PATENT-CLASS-427-40 ..... N78-31233*
US-PATENT-CLASS-427-41 ..... N78-31233*
US-PATENT-CLASS-427-164 ..... N78-31233*
US-PATENT-CLASS-428-411 ..... N78-31233*
US-PATENT-CLASS-428-412 ..... N78-31233*
US-PATENT-CLASS-428-422 ..... N78-31233*
US-PATENT-CLASS-428-447 ..... N78-31233*
US-PATENT-CLASS-428-515 ..... N78-31233*
US-PATENT-CLASS-428-523 ..... N78-31233*
US-PATENT-CLASS-428-538 ..... N78-31233*

US-PATENT-4,010,455 ..... N78-31426*
US-PATENT-4,081,250 ..... N78-31527*
US-PATENT-4,091,166 ..... N78-31233*
US-PATENT-4,091,464 ..... N78-31735*
US-PATENT-4,091,465 ..... N78-31736*
US-PATENT-4,091,665 ..... N78-31129*
US-PATENT-4,091,798 ..... N78-31526*
US-PATENT-4,091,800 ..... N78-31525*
US-PATENT-4,092,188 ..... N78-31255*
US-PATENT-4,092,274 ..... N78-31232*
US-PATENT-4,092,648 ..... N78-31321*
US-PATENT-4,092,874 ..... N78-31426*

USAAEFA-75-04 ..... N78-31091 #

USAAMRDL-TR-77-34 ..... N78-31096 #

USAARL-78-5 ..... N78-31742 #

USAAVRADCOM-CR47-M-78-01 ..... N78-31113 #

USAAVRADCOM-TR-78-9 ..... N78-31094 #

USAAVS-TR-78-2 ..... N78-31092 #

USAEHA-TC-084 ..... N78-31900 #

USAEHA-51-1309-78 ..... N78-31715 #

USARTL-TR-77-51 ..... N78-31952 #
USARTL-TR-78-2A ..... N78-31089 #
USARTL-TR-78-4 ..... N78-31115 #
USARTL-TR-78-6 ..... N78-31110 #
USARTL-TR-78-10 ..... N78-31119 #
USARTL-TR-78-11 ..... N78-31114 #

USCG-M-4-78 ..... N78-31065 #

USGS-474-255 ..... N78-31651 #

USNA-EW-6-78 ..... N78-31941 #

UTIAS-209 ..... N78-31835 #
UTIAS-219 ..... N78-31591 #
UTIAS-227 ..... N78-31269 #
UTIAS-228 ..... N78-31875 #

UW/RF-2 ..... N78-31471 #

WPPS-THE-039 ..... N78-31273 #

WPS-HP-S-73-1-9-VOL-121 ..... N78-31645 #

WMO-494 ..... N78-31676 #
WMO-500 ..... N78-31677 #

WQEC/C-78-1 ..... N78-31540*#

WRE-TR-1921(W) ..... N78-31668 #

WRRI-BULL-28 ..... N78-31968 #

WWW-PLR-36 ..... N78-31676 #

W78-05932 ..... N78-31518 #
W78-06036 ..... N78-31658 #
W78-06064 ..... N78-31519 #
W78-06347 ..... N78-31608 #
W78-06409 ..... N78-31622 #
W78-06412 ..... N78-31523 #
W78-06580 ..... N78-31522 #
W78-06807 ..... N78-31966 #
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